THE GLASS INDUSTRY

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BALL MUNCIE REVITALIZES PRODUCTION, SALES, AND SERVICE

Ball Brothers Company, once called the "sleeping giant" of the glass industry, has awakened with a stir that is being felt throughout the Central States, heartland of the glass container industry where 35 per cent of all glass container sales are made.

A revitalization of the Ball company, a process that started three years ago this summer, has brought with it a new management with new perspectives, new manufacturing tools, new emphasis on controls and materials handling, higher quality, increased productivity, the highest employment and payrolls since World War II, and major plant modernizations.

By next March, Ball executives told THE GLASS INDUSTRY, the company will have substantially completed expenditures of several million dollars for a vastly improved operation at their Muncie, Ind., plants. They say that this big Muncie facility, strategically in the heartland of commercial glass container usage, will be as modern as any in the nation engaged in production of narrow neck and wide mouth ware and serving customers with overnight delivery.

Four men, backed by the full directorate of the company, the stockholders, and others in all levels of management, have been largely responsible for the sweeping changes that already have taken place, changes that will continue until the firm's rebuilding and modernization program is completed.

The four men are Edmund F. Ball, President; Duncan C. Menzies, Executive Vice President and General Manager; John W. Fisher, Vice President and Director of Commercial Container Sales; and Robert W. Biggs, Vice President and Manager of Glass Manufacturing.

Only one of these four men has reached the age of 50. Thus, their operational and marketing viewpoints are as fresh as the Ball plants are becoming modern. Mr. Ball became President of the 70-year-old firm in 1948 at the time George A. Ball relinquished that office and became Chairman of the Board. Two and a half years later, Mr. Menzies, widely known authority on modern management and marketing, resigned a high executive position with Johnson & Johnson to become Ball's chief operating officer.

Mr. Fisher, who had been a Ball manufacturing official for a dozen years, was chosen to head a new, hard-hitting sales organization, and Mr. Biggs, one of the country's leading production men, took over manufacturing responsibilities.

The four, plus Alexander M. Bracken and George E. Myers, both vice presidents and members of the Executive Committee, serve as the nucleus of a management team that developed a completely new Muncie operation and a firm position in the industry.

Ball Muncie glassmakers compete in 17 container classifications now and very likely will broaden their lines considerably, they say, as their four-year program continues to unfold. In the 17 classifications in which Ball is competitive at the moment, sales at the end of the first six months, this year, were 30 per cent higher than in the corresponding period of 1952. The industry as a whole in these classifications was only 9.2 per cent better than a year ago. Those figures were reported at a recent meeting of the Ball Board.

The answer to the question of how this somewhat phenomenal record is being accomplished lies in a recounting of what has been happening in Muncie since 1950.

Broadly speaking, this is best summarized by President Ball himself. "For the past two and a half years," Mr. Ball explained, "our efforts have been concentrated on improving quality of assets, building a strong liquid position, increasing reserves, rebuilding and modernizing plants, strengthening and improving management, and providing management and employees with the modern tools it takes to do the job. Today we're consolidating our gains."

The actual job of modernization started early in 1952. The first thing the company did was raise nearly 22,000 square feet of roof over the whole forming area of No. 1 Factory so that eventually two furnaces could be rebuilt on a wholly new design with higher metal levels to accommodate I-S machines as well as JPM and Lynch. The objective: greater flexibility of operation.

These two high-level tanks will be constructed from the ground up within the next five months at a cost conservatively estimated at $500,000 a furnace. The company has taken delivery on some of the new machines and new feeders that will be used when these two new furnaces go into production.

New "model" tank which incorporates many new design features and is being operated under low pressure at 30 per cent fuel saving.

Older style Ball furnace, one of four scheduled for reconstruction which will incorporate features of model tank shown to the left.

Meantime, a team of Ball engineers, including Reginald W. Morgan, Manager of Central Engineering Services, Glenn Gregory, Ceramics Engineer and widely-known glass technologist, James S. McCormick, and Arthur Dirlam, developed plans and specifications for a new furnace that was to become the model for all future tank construction at the Muncie plants.

The model furnace went into construction in No. 2 Factory December 1, 1952. Into its construction were incorporated a number of advanced design features, which Ball production men report have proved "most satisfactory" in actual operation.

The company spent close to $250,000, exclusive of engineering costs, to establish its model furnace with the best electronic equipment available to control heats, drafts, dampers, fuel flow, metal levels, feeder temperatures, and produce glass of constant high quality.

Ball began production on the model furnace, fired under low pressure, in mid-February and in the 150-odd production days since its campaign started, the tank has consistently produced good commercial glass of uniform quality on 30 per cent less fuel.

The company didn't stop with just a tank construction, however. It installed a new roof, a new ventilating system, revamped the whole selecting and packing areas to include new conveyors, a better lighting arrangement, and new carton forming machinery. The ventilating system incorporated a baffle wall that shunts fresh outside air down across the blowing room floor to expel heat and smoke from the forming areas. This baffle is a Ball innovation and materially improves working conditions in the blowing room. The new roof, of fire resistant materials, is an adaptation of a louver design.

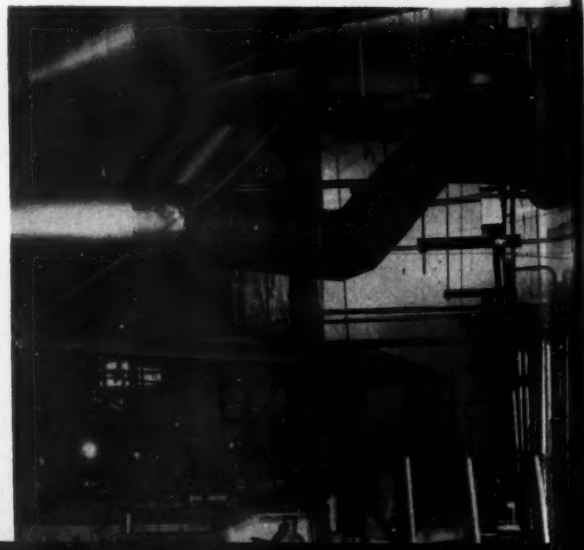
In all, four major tank construction projects are on schedule. They are the two furnaces in No. 1 Factory that will be rebuilt from ground up at high level and two more in No. 2 Factory, presently operating at high level and whose reconstruction, likewise, will incorporate all the features of the model tank now operating.

Furnace modernization and reconstruction, including new forming machines, feeders, and control devices, will have cost the Ball Company about $2,250,000 by the time this particular phase of the program is completed in 1954.

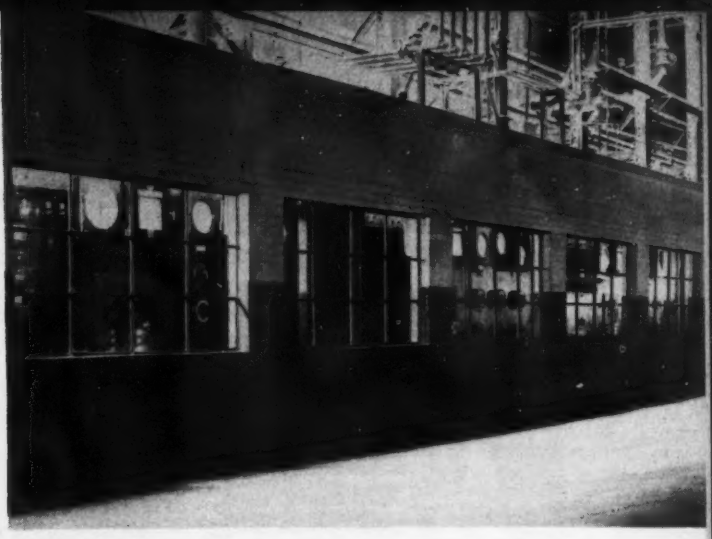
The program in its entirety, according to Mr. Menzies,

The forming area served by new model furnace. Operations were in progress when this picture was taken looking east from center aisle. Note baffle wall in right upper half of picture and smoke-free conditions.

This photograph was taken as companion to photo at the left from the exact spot in the center aisle, but looking west. Note dense smoke beyond baffle wall. This forming area is to be reconstructed when furnaces are rebuilt.



Interior of new Control House at No. 2 Factory, where model tank was installed and where two additional furnaces are scheduled for rebuilding.

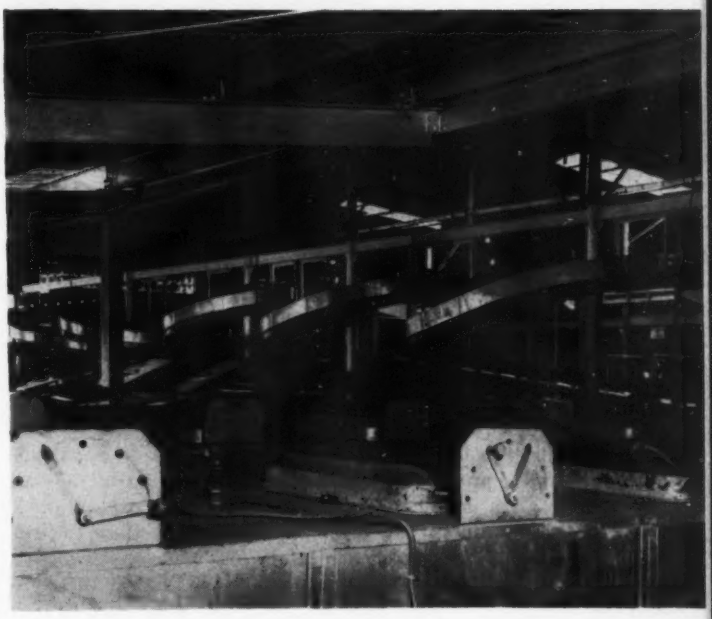


Exterior of Control House.

"has been predicated on a fact that industry generally and the glass container manufacturer in particular faces the keenest competitive period in history. We must be a low cost producer and offer special services that will help make this product more competitive; more salable.

"Our modernization, accompanied by applications of the very latest controls," Mr. Menzies continued, "was designed so that Ball is now producing, at low cost, glass containers that meet customer specifications in all respects. In addition, we have established service sections which make available to the customer counseling in glass container, closure, label, and shipping carton design as well as a market research group for the customer who may want help in solving his problem of marketing."

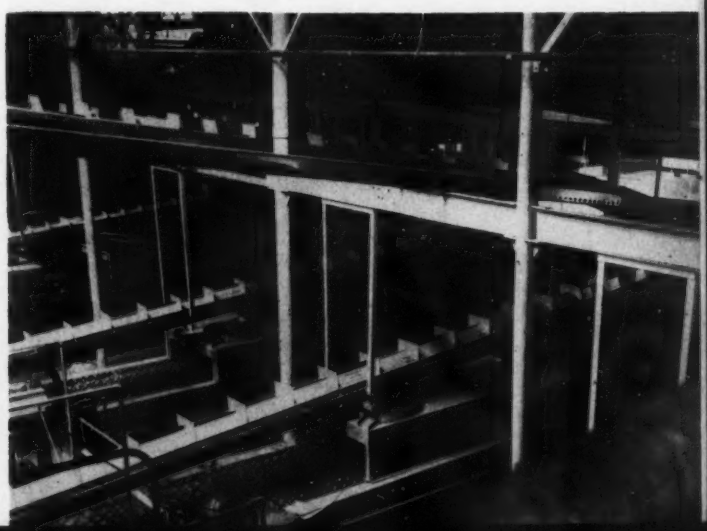
Focal point of all the manufacturing controls about which the Ball Executive Vice President spoke is found in a newly-established glass control laboratory which the company built and equipped with all the latest devices and apparatus it takes for analyses through the whole process of making glass and glass containers. This new control center represents the outlay of another substantial sum of money. It has been in operation less than a year under the supervision of Mr. Gregory, chief technologist, who joined Ball in 1952 to organize and supervise a whole new system of checks and controls.



New carton conveyor installations.

New glass control laboratory. Glenn Gregory, right, Ball's ceramic engineer, and Loren Hunt, left, of the lab staff.

Carton conveyors and lehr system shown from carton forming mezzanine.



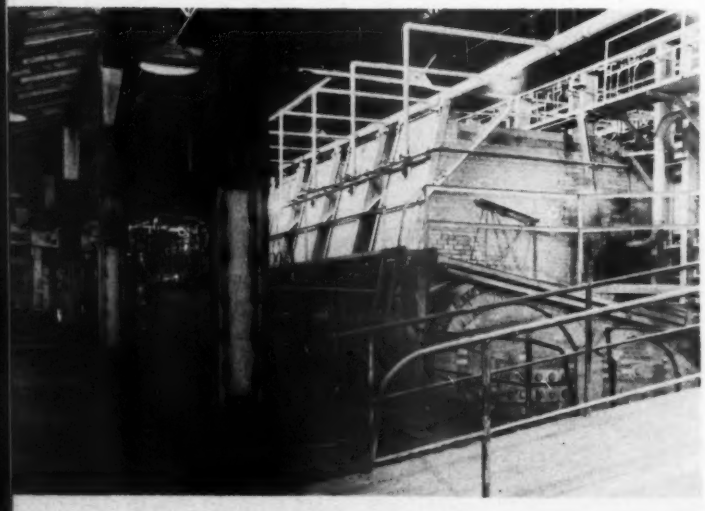
A section of new roof installation showing louver-type ventilating system.

A second laboratory also was under construction in August and probably will be in operation by the time this reaches print. This one will be for controlling the quality of paper and paperboard used in customers' cartons and for the development and refinement of specifications and design whenever the customer desires new packaging or new shipping containers.

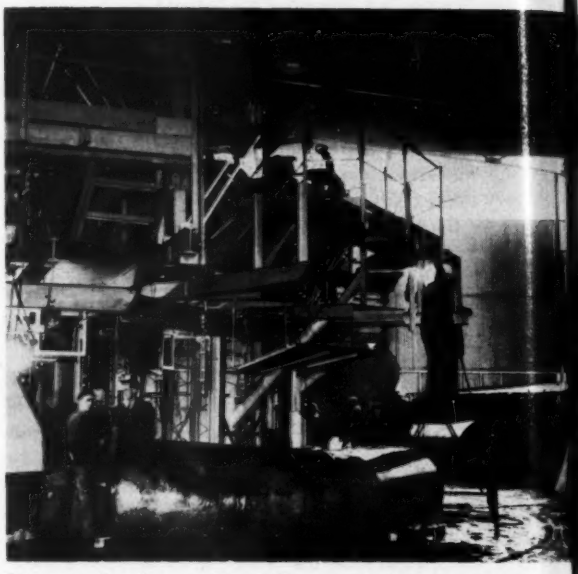
Another project under way will result in a major overhauling of all materials handling throughout the Muncie properties which spread over 70 acres and of which 53 acres are under roof. The company allocated several hundred thousand dollars toward this tremendous job of streamlining all movements of raw materials into the plants, materials handling during manufacture, and the movement of finished products from production lines and warehouses.

It was indicated that the allocation merely would initiate a project that will bring the relocation of railroad tracks, truck spotting areas, new centralized car and truck loading docks, new batch handling, and a more efficient utilization of warehousing facilities now capable of accommodating 550,000 gross of ware.

Photograph taken during roof raising over No. 1 Factory. Light section of steel columns represents the insets that were necessary to elevate the roof seven feet.



Glass control laboratory.



Photograph taken at No. 2 Factory during reconstruction early this year. Model tank construction is shown.

Ball has had its engineers make preliminary studies and estimates for the installation of the most modern batch making and batch handling equipment available. This installation, an important aspect of materials handling, will require the expenditure of between $800,000 and $1,200,000, depending upon the system or systems the company chooses. Under consideration are a central batching plant to serve the two Muncie factories and a unitized installation for each plant.

The company has not yet placed an estimate on what the total materials handling streamlining will cost, "but it will be an investment considerably beyond those we have made thus far to modernize properties," according to Mr. Biggs, whose progressive production methods have turned the Muncie Glass Division toward lower costs and better quality of products.

"What we did," Mr. Biggs said, "was to audit all of our equipment and study our methods and procedures, then replace obsolete machinery with new and modern equipment and replace antiquated practice with new and

(*Continued on page* 503)

LECTURE VERSION OF PAPER ON ANNEALING AS GENETICS

By F. W. PRESTON

Preston Laboratories, Butler, Pa.

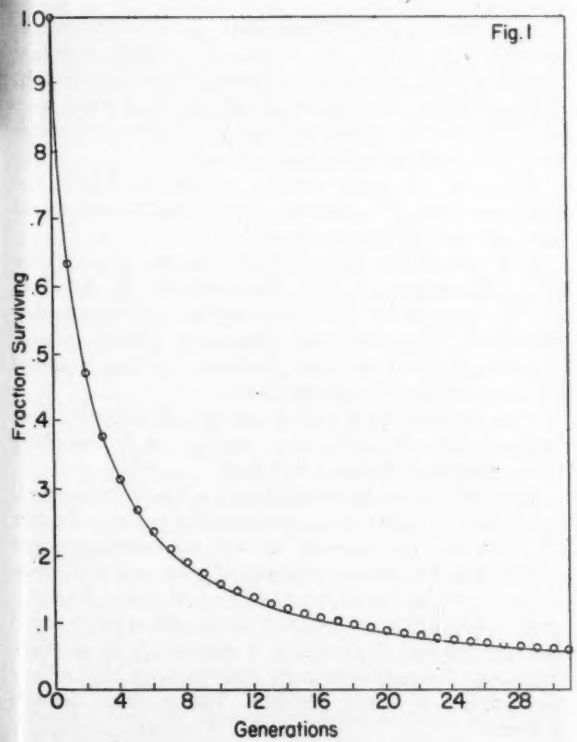
Editor's Note: At the Glass Division Meeting at Bedford Springs, Pa., last fall, Dr. Preston presented a paper, "Annealing as a Problem in Genetics." Subsequently an extended version of this talk was presented in the *Journal of the American Ceramic Society*. Since the shorter version given at Bedford Springs differed in treatment and not merely length from the paper appearing in the Society *Journal*, it is felt that publication of the lecture in THE GLASS INDUSTRY substantially as it was given last fall would be well received by our readers.

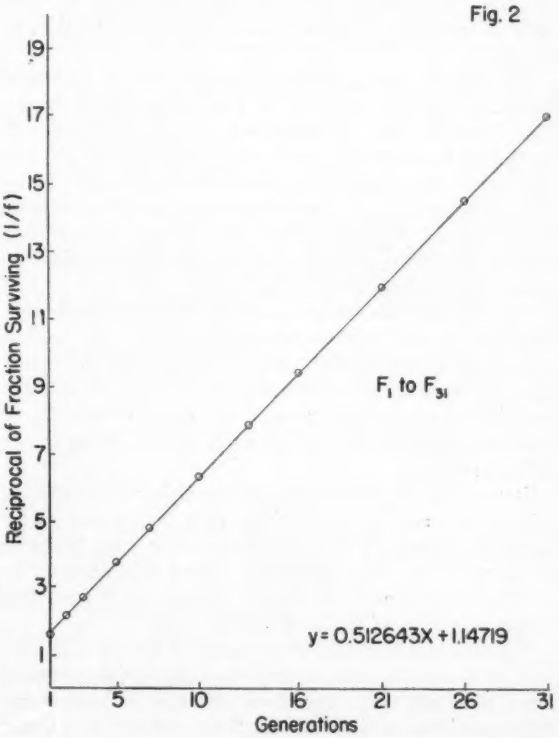
In this room just four years ago I had the privilege of speaking to you about Poisson Series. You will remember that I began by asking you: "If there are three hundred and sixty-five of us here today, how many days in the year are no-one's birthday?" and when you did not give me the answer immediately, we experimented on the subject by dropping a hundred glass marbles at random into a hundred glass test tubes on a revolving deck to see how many test tubes were finally empty. Charlie Pearce, Sam Scholes, Parikh from India, and Fay Tooley did the experimenting. From this we went on to consider the general properties of Poisson Series in a very elementary fashion.

Today we are going to consider a much more advanced application of the Laws of Chance, starting with a Poisson Series, which leads to some rather startling discoveries. I do not know whether what we discover will be a very important discovery or a mare's nest. It may be one or the other, but I do not think it is possible for it to be somewhere in between. But we can leave that for you to figure out later.

The question we ask today is this: Suppose that a thousand of us are here today, and none of us is related to anyone else nor has the same name. Let each of us give rise to a large number of offspring, say fifty apiece. Then let us of this generation all die promptly. Then set a nit-witted giant loose among the 50,000 offspring and let him slay them at random till only one thousand remain. How many of our surnames will be missing thereafter? This is easy. But now we repeat the process. The members of this generation of our offspring themselves each produce fifty offspring, die themselves, and enough of their pool of offspring also die, till the numbers are again one thousand. How many of our names will survive in this second generation? And so let us continue. The generalized problem is, how many of our names survive in the tenth, the one-hundredth, the nth, and to infinitely distant generations?

It will be obvious that in the first filial generation, that is, the generation that immediately succeeds us, we are dealing with a simple Poisson Series. We dealt with that question before. It may happen that in that generation I shall leave no offspring, while Charlie Pearce compensates by leaving two. But even if he does, it is still possible for him to become extinct in the next generation. Those of us who become extinct can never be re-activated, but those who survive always have a chance of becoming ex-





tinct. Thus, the number of surnames tends to become less with each generation.

I shall not immediately go into the mathematics of it. I thought it had not been investigated previously, but I find that Professor R. A. Fisher, now of Cambridge, England, had really solved it some twenty or thirty years ago in another guise. The method of computation is an iterative process, a step by step computation. The general formula, by means of which the survivors of the $\overline{n+1}$th generation are found in terms of the survivors of the previous generation, is simply $y_{n+1} = 1 - e^{-y_n}$.

Figure 1 plots the results as far as the 31st generation. The circles are at the computed points, but the curve drawn among them is not the curve with the equation we have just set forth. Instead it is the curve of the Adams and Williamson law of annealing. That law is a rectangular hyperbola so that if, instead of plotting stress (or birefringence) against time, we plot *reciprocal* of stress against time, we get a straight line.

Figure 2 shows the effect of plotting reciprocal of fraction surviving against number of elapsed generations; it could hardly be a better straight line.

In a recent paper it is shown that the Adams and Williamson law presents a formal mathematical difficulty, and that this and the physical difficulties can be eliminated by rewriting it in such a way that the formula itself implies a changing constitution. But the factor that implies this is not deduced from any basic considerations. The formal difficulty is removed, but the mechanism remains obscure.

Now, Adams himself has stressed the point that his formula is strictly empirical, so that any other formula that will fit the experimental facts will do equally well. On the basis of the graphs that you have seen, we might well claim that the Fisher formula meets the requirements. Further, it does so without introducing any formal difficulties, and it gives, although only in the form of a parable or analogy, a logical reason for expecting this behavior.

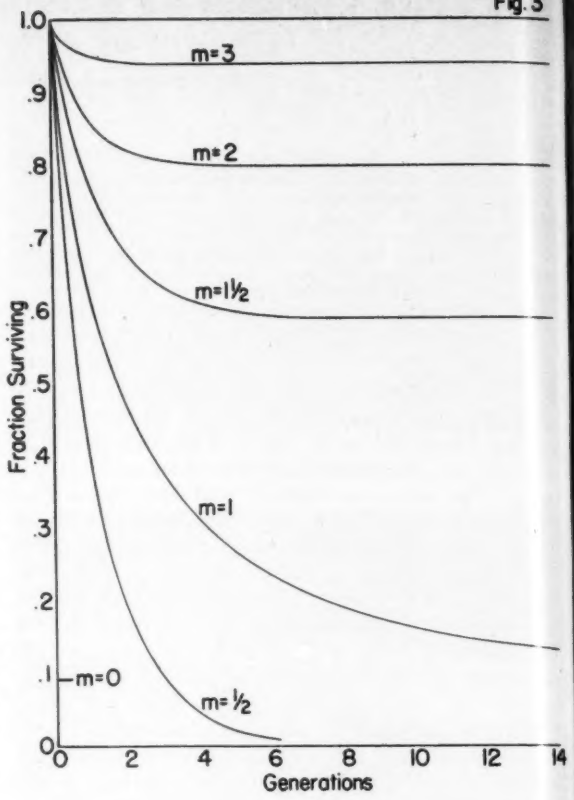
We assume that a piece of optical glass is populated by a vast number of units or individuals called "polarons." Initially they are unrelated and unharmonious. At annealing temperatures each polaron tends to pass into a variety of other states, determined by the laws of chance. One of these states is the extinct state, and if it reaches this state it is not re-activated. The process of annealing is then a process of reducing, by random selection, all polarons to a single harmonious family.

We may go one step further. We have assumed up to date that we are in effect unisexual animals. We took no account of blood-relations established through the female line. But now let us assume that we are bisexual and that our line is not extinct, though our surname may be, so long as any blood of ours, however diluted, flows in any living creature.

It can then be shown that the formula we are dealing with is $y_{n+1} = 1 - e^{-my_n}$. Here m is the number of cooperating units. In the case we are now considering m = 2, one male and one female. When this happens, we can lose only about 20% on our "lines," or in annealing terms, only 20% of our birefringence.

We can, however, where annealing is concerned, envisage the possibility that we may need the collaboration of more than two units, say three. Or that we may sometimes need two and sometimes three, averaging two and a half. The mathematics is simple in any case, and the formula is still that of the preceding paragraph, with m taking any value we like. This results in processes graphed in Figure 3.

Fig. 3



If we take m greater than unity, the stress cannot be completely annealed out. Some of it will disappear quickly, but the rest will be stubborn and stay indefinitely. This is what Dr. Ghering found with the GCA strain discs at 200°C. It also resembles what the Geophysical people found at somewhat higher temperatures.

If we take m equal to unity, we get the Adams and Williamson law of annealing. This corresponds to annealing at the ideal temperature.

If we take m less than unity, we can anneal out all the stresses in very short order. However, after the first generation or two, the law is exponential, not rectangular-hyperbolic. This is the law Adams and Williamson were expecting, but did not find. Perhaps it occurs at rather higher temperatures than they used.

If we put m equal to zero, stress anneals instantly. This happens when the glass is so hot that it is essentially fluid. Possibly it defines a true fluid.

Now, all that we have said forms a reasonable picture, and it may appeal to us as involving the concept of quantized process. The steps are discrete, not continuous, and I think that the ultimate structure of glass, not being continuous, can hardly be expected to give other than discrete results. However, it must not be taken for granted that the process of annealing is necessarily as we have indicated. We may have come close to describing it, and the approach is at any rate new. That is all we can say at present.

THE SELECTION AND OPERATION OF GAS-FIRED LEHRS

By HARVEY C. WELLER

Surface Combustion Corporation, Toledo, Ohio

Introduction

The ever-rising demand for glass products of unusual composition and shape, whether pressed, blown, flat drawn, or made by other methods of manufacture, has resulted in wide progress in the glass industry. Very few glass manufacturing processes have been left unaffected by this momentum which is still on the ascent.

Many innovations have been made to meet the increasing necessity for improving existing methods of fuel application with a view to offset in some measure the general advance in manufacturing costs. Prominent among these is the advance made in the understanding and the full use of annealing principles. Not too many years ago a piece of paper was thrown into an annealing tunnel or "lehr" and watched for the time elapsed to reach kindling temperature. This was typical of some of the rule-of-thumb procedures then used for determining annealing temperatures. Annealing today in modern gas-fired lehrs constitutes one of the major chapters in the art of glass-making since this process may well be the last to follow the production procedures.

The Process of Annealing Glass

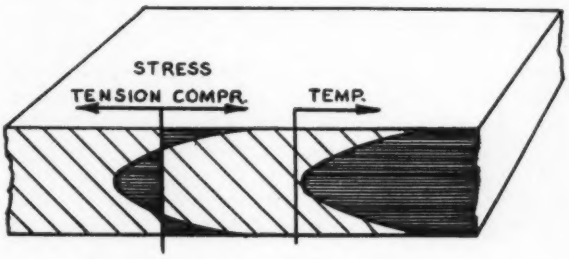
After glass has been formed to its final shape and after initial cooling from the molten state, the resistance to flow, or viscosity, increases rapidly with decreasing temperature so that at room temperature the viscosity is so great as to be considered almost infinite. If a load is quickly applied, glass seems to be perfectly elastic unless fracture occurs due to cracks or fissures previously contained in the surface. This phenomenon indicates that strength of glass is a function of its surface conditions.

In annealing or stress relieving, a piece of glass can be considered as an amorphous but homogeneous substance in which no chemical change occurs. The thermal conductivity of glass is very low, about 2% that of steel, although the coefficient of thermal expansion may sometimes approach that of steel. Consequently during the annealing or cooling process, the differences in temperature throughout the cross-section of the mass are much greater in glass than in steel, resulting in greater thermal "strain." The efficiency of the annealing schedule is determined by the amount of residual "stress" left in the glass. While these terms are interchangeably used, stress is calculated per unit area but strain, when viewed in the polariscope, is recognized by the differently colored areas. These differently colored areas designate elastic deformation due to stress causing optical effects. Glass which has been slowly cooled from its viscous condition to the elastic or rigid state using a controlled time-temperature rate of cooling has small thermal stress and can be considered "annealed."

When a slab of glass is heated from room temperature to a higher temperature, heat is flowing from either surface toward the center of its cross-section with a temperature drop in the direction of heat flow. Because glass expands with heating, there is a temporary compressive stress at the surface, balanced by a tensile stress in the center layers of the slab (Fig. 1). Due to this condition of compressive strength on the surface, any particular glass can be heated much faster than it can be cooled, provided the piece is heated uniformly throughout.

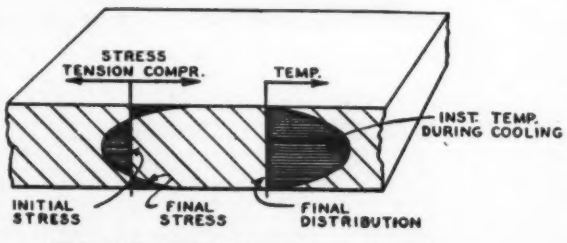
In cooling glass at a uniform rate, tensile stress will occur in each surface but will be balanced by a compressive stress at the center of the cross-section. The temperature will be at a minimum at each surface of the glass and at its maximum at the center. As the slab continues to cool at a constant and uniform rate and since no new stresses have been introduced by a change in the relative temperature of the center and surface layers, the glass approaches the end of the cooling or "annealing" cycle with no internal stress. During this cycle, however, the glass changed from a viscous to a rigid elastic mass. At the end of the cooling period and when the glass reaches temperature equilibrium, the disappearance of internal temperature gradients will set up definite stresses. At the start of the cooling period the center of the glass was initially hotter than the surfaces and while continuing to cool to the surface temperature, the center layers will undergo greater contraction, resulting in a compressive stress in the surfaces of the glass balanced by a tensile stress in the center layers of the glass slab (Fig. 2).

The temperature at which internal stress in glass is potentially relieved through internal viscous flow in fifteen minutes is considered the upper end of the annealing range. This temperature has been defined as the "Annealing Point" by the American Ceramic Society Division Committee on Nomenclature. The "Strain Point" is defined by that Committee as the highest temperature from which strain-free glass can be cooled quickly without in-



HEATING GLASS AT UNIFORM RATE

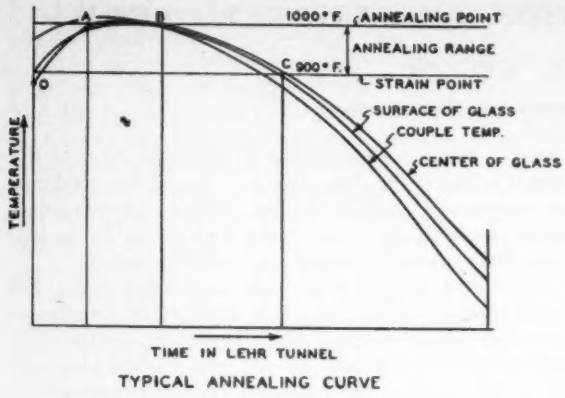
Fig. 1.



COOLING THROUGH ANNEALING RANGE AT UNIFORM RATE

Fig. 2.

Presented before the American Gas Association, Industrial and Commercial Gas Section.



TYPICAL ANNEALING CURVE

Fig. 3.

troducing permanent strains. This latter is the lower end of the annealing range. If the physical properties of the glass to be annealed are known, the end stress or residual stress can be calculated as compression per unit area at the outer surface of the glass. This residual stress is a function of the temperature differential from center to surface and of the relative cooling rate through the annealing range.

Logically, glass should be heated to a temperature somewhat above the annealing point, held long enough to assure uniformity, and then cooled through the critical range to the strain point and cooled as rapidly as is possible without setting up undue temporary stresses to about room temperature.

A typical annealing curve is shown in Fig. 3 and it should be noted that three curves are plotted for clarity in evaluation of the temperature differentials between the center of the glass, its surfaces, and the indicated lehr temperature.

Analysis of this representative time-temperature curve will show that the temperature of the glass as charged into the lehr tunnel is lower than the lehr temperature which is preferably held slightly above the annealing point. The time interval from "O" to "A" will cause surface and center temperatures of the glass to equalize at a point within lehr temperature range. It may be assumed that the center temperature has already passed the annealing point and the soaking period can be started until "B" is reached at which point there is no temperature gradient in evidence. The desired precalculated strain will be obtained by controlled cooling through the critical zone between points "B" and "C." While the glass center temperature is still somewhat higher than the lehr tunnel temperature, acceleration of the cooling gradient may start after passing point "C" but the natural effect of heat radiation from the glass mass itself to the lehr walls will limit the rate of cooling to approximately room temperature. It can safely be said that after the glass has reached a temperature below 500°F., no temporary stresses will be set up and the acceleration of the cooling gradient is merely dependent upon the means available in the lehr design to effect this result.

The Design and Operating Requirements of the Lehr

High quality of annealed glass is a function of the above considerations. These must be observed in all three phases of the annealing cycle: (a) soaking or holding at the "annealing" temperature, (b) initial cooling through the "critical range," and (c) "final cooling" to or safely above room temperature.

In general the glass industry produces a vast diversity of products, each with appropriate properties and manufacturing requirements. A glass container, a consumer's item to be discarded after the contents have been used, requires a certain degree of annealing. On the other hand, the optical industry evaluates the residual stress in an expensive lens or range finder from entirely different physical and economic standards. In other words, the lehr design is governed by the physical specifications and use of the glass product, as well as the economics of its sales price.

The law of diminishing returns must always be considered in setting standards of annealing lehr performance. In either extreme case the design of the lehr and its operating qualities will have to be flexible enough to meet the desired or accepted annealing requirements.

While the structural phases of a continuous furnace or lehr can be met within sound engineering knowledge and from experience, the application of fuel for the various stages of heat requirements calls for a most definite approach. In modern glass annealing, decorating, or heat treating practice, the semi or full muffle lehr is going the way of propeller-driven military aircraft.

Protective muffles are used in heating processes where the combustion products may tend to influence the proper atmosphere and affect the physical characteristics of the ware in the heating tunnel. The heat capacity of a muffle varies with size, construction, and the material used. The

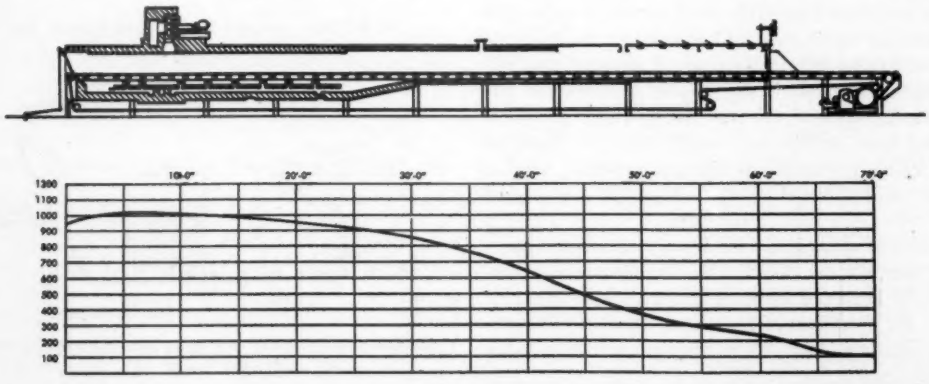
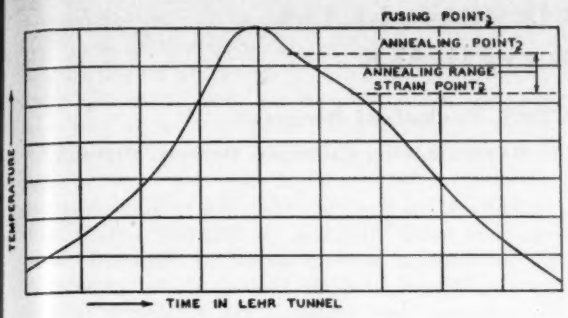


Fig. 4.



TYPICAL DECORATING CURVE

Fig. 5.

thermal efficiency of muffle lehrs again depends upon the design and mode of operation. Since a high temperature working head is required for heat transfer through the muffle to the lehr tunnel, it follows that all heat generated at temperatures higher than the actual lehr temperature can be considered waste unless provision is made for waste heat recovery.

Muffle lehrs are still in use in certain glass plants but time, aside from replacement expenditure, will call for more efficient methods of applying heat to glass passing through an annealing tunnel. Oil is being used for fuel in certain localities. Since its controllability is within certain limits, it must be preheated and gasified before any available Btu's, in gas form, can be economically applied to the annealing process. Electricity can be used in small cross-sectional lehrs to good advantage, but its application to wide production lehrs is generally not recommended. If the glass could be turned about its own axis continuously, the results might be adequate but in nearly all installations the price paid for doing so could not be absorbed in sales. Convection plus radiation is by far the most economical means of uniformly heating glass.

The thermal efficiency of an electrically-heated lehr is normally much higher than that of a fuel-fired furnace. The difference is represented by the amount of heat carried away in the waste products of combustion. Identical thermal efficiencies would be obtained if waste heat utilization were carried to the economical limits.

The heating requirements of annealing and decorating lehrs ranging from 800° to 1250°F., depending upon the type of glass processed, demand a fuel as controllable as electricity. Nearly all glass processing calls for an oxidizing furnace atmosphere. Gas fuel lends itself to the creation of such an atmosphere and is also readily controllable.

As previously stated, the best grade of annealing results if the glass is subjected to uniform heat treatment at all times during the annealing or decorating cycle. The intelligent application of gas fuel, plus controlled recirculating of the heating gases within the lehr tunnel, has been very successful. Reduction of the heat gradients within the glass can be still further advanced by the proper use of automatic temperature control equipment.

In one successful type of lehr, gas fuel is burned under proportioning control at one or more points in the heating zone of the tunnel. The heat is then distributed underneath the conveyor belt by means of one or more recirculating fans. As the gases flow up through the belt and past the ware loaded thereon, a rapid equalization of temperatures in all parts of the glass is effected, as is necessary for quality annealing. The temperatures within the lehr tunnel are kept only slightly higher than the glass temperature as the first essential of the heating operation and the use of heavy refractories in any tunnel section, as called for by the time-temperature curve, can then be held to the economic minimum.

The design features of such a direct gas-fired annealing lehr are shown schematically in Fig. 4. In setting up the time-temperature cycle, it is advisable to run a traveling couple through the lehr tunnel prior to setting the individual dampers. Heat demand in the charging end of an annealing lehr is a direct function of the belt speed and the amount of ware loaded. The annealing zone burners supply only that amount needed to satisfy the difference between the wall radiation losses and the heat received from the cooling glassware. As the load increases, the heat demand decreases in proportion, but all functions—preheating, holding, and annealing—should be automatically controlled. When the desired annealing curve has once been established, there should be no further need for adjustment when annealing glass of the same composition. In addition to controlling the fuel supply to the various zones, the supply of recirculating air may also be adjusted to control the slope or convexity of the cooling curve. It is important to hold the soaking portion of the curve reasonably flat with a slow initial cooling rate through the critical zone. A gradual increase in the fast cooling rate, reaching the maximum toward the exit end of the lehr, is desirable.

Annealing and cooling rates vary with different glass compositions. Low expansion glasses such as borosilicate glasses require somewhat higher annealing temperatures than soda-lime glasses but can be annealed to a given stress with more rapid cooling through the critical zone and as fast as possible in the final cooling zone, unless the particularly intricate shape of the ware will not permit this annealing procedure.

The Process of Decorating Glass

The design and operation of a glass decorating lehr follows essentially the one described under annealing. After the decorations have been applied, the cold glass is charged into the lehr. It is then necessary to preheat the glass to the annealing temperature and then raise the temperature approximately 100° to 150° above the annealing temperature in the firing zone. As soon as the ware reaches this specified firing temperature, it should be cooled to the annealing temperature of the glass. The annealing cycle previously described is then followed.

The ceramic pigments or enamels used on glass have a lower softening temperature than those used on porcelain or steel but the glass itself cannot be heated much above its annealing temperature without deformation. To secure chemical stability and physical hardness, it is of course desirable to find temperatures the glass itself will stand. A typical time-temperature curve is shown on Fig. 5. It can be observed that the preheating time is roughly one-third of the entire curve. If breakage of the ware occurs, it should be determined whether the glass breaks in the preheating or annealing portion of the lehr tunnel. If glass breaks in the preheating zone, the heating rate is excessive, especially below the critical range. However, if fracture occurs in the annealing or cooling zone, it is

(*Continued on page* 504)

HOW TO BOND FIBROUS GLASS TO OTHER MATERIALS

By Dr. WILLIAM J. CLAYTON, Technical Director

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Fibrous glass pads are constantly gaining in popularity for insulating and sound deadening applications because they offer, first, definite engineering advantages and, second, attractive appearance where that factor is important. Among the advantages of fibrous glass pads are: light weight, permanence, flexibility, strength, resilience, vermin and mold resistance, usefulness through a wide temperature range, and absence of matting or sagging. Where required, facing materials attached to the surface of fibrous glass offer both a decorative appearance and insulating qualities necessary for the particular application.

Along with this wider acceptance and application, there is naturally considerable interest in the best method of holding pads in place. Two basic methods are used to secure fibrous glass pads in place: adhesives and mechanical fasteners.

The most versatile and effective method of fastening to many types of surfaces including metal, wood, concrete, etc., is with adhesives. Although adhesives work equally well with all these materials, the surface most commonly encountered is metal. Duct work, metal buildings, automobile hoods and roofs, pipes, railroad cars, furnaces, and ship compartments are a few of the metal surfaces to which the insulating and sound deadening panels are applied.

In addition to being easy to use, adhesives also provide a permanent resilient cushion between the fibrous glass and the subsurface. The cushion, in many cases, acts as a partial sound deadener and supplements the fibrous glass pad in this respect.

To the manufacturer installing the fibrous glass pads, adhesives offer these advantages: (1) Adhesives are the only method of fastening that have characteristics similar to the fibrous glass itself and maintain these properties as all temperatures within the range of the insulation. (2) Fibrous glass material is not compressed no matter how low the density, allowing complete utilization of the insulating properties of fluffed glass materials over the entire insulated area. (3) The metal need not be pierced. This factor is of major importance in automotive, appliance, and similar applications where appearance is paramount. (4) Fibrous glass is in contact with the entire surface area of the metal and stresses are distributed evenly. (5) The danger of cutting through the insulating blanket is eliminated. (6) Expensive equipment is not needed to apply fibrous glass pads using adhesives. Only tools needed are a brush, trowel, or spray gun.

In addition to being the only way to fasten insulating material on many jobs, adhesives have the added versatility that enables them to be used in conjunction with mechanical fasteners on applications where the fasteners can't do the job alone. Applications include those where clips, bands, wire, or twine are used and adhesive is dabbed on to hold the pads in place until they can be permanently secured.

Surface of the metal *must* be clean to insure a strong, permanent bond. Abrading, sandblasting, solvent washing, or chemical cleaning should be employed. Kerosene should never be used. There is *one* exception to the rule requiring clean surfaces. The automotive industry found that it took too much time to clean the protective oil film or drawing compound from steel roofs so 3M developed an adhesive (EC-321 and its variations) that will absorb the oil and pick up adhesion to the metal.

Fibrous glass pad consistencies range in density from ¾ to 6 pounds per cubic foot, making available pads that may be soft and flexible or rather hard and rigid. Flexibility decreases as the density increases. Thinner, more flexible pads come in roll form, while the high density materials are in block or board form. Either type can be easily and permanently fastened with adhesive. Low density pads are used in automobile hoods, for insulating quonset huts, etc. High density pads are used on concrete building walls, inside air ducts, and similar applications where heavy duty insulating and deadening pads are required.

Specific Applications

Low density pads, ½ to 2 inches thick, insulate the engine compartment of many automobiles and also act as sound absorbers and vibration dampeners. This application is an excellent example of a job where adhesives are the only practical solution. Since the job is done on assembly lines, welding, brazing, or soldering mechanical fasteners in place would require special equipment and be time consuming. Appearance rules out using fasteners that would pierce the hood.

Adhesives overcome all these objections and do the job in a matter of seconds. Application is to one surface (either the pad itself or a cleaned metal surface) and the pad is pressed into contact with the metal hood within a minute or two. Once in contact with the metal, the pad is held tightly and permanently, permitting the car to be jostled, jarred, and even driven immediately.

Adhesives for bonding these pads must be sprayable, rapid drying, or strong even when wet, and must retain sufficient strength to hold the fibrous glass pad firmly at temperatures ranging from —20°F. to nearly 200°F. For this job Minnesota Mining and Manufacturing Company has developed a solvent solution black reclaimed rubber based adhesive (EC-226) that can be sprayed or brushed on and a water dispersed black reclaimed rubber based adhesive (EC-321) that can be roller coated, sprayed, or brushed.

The solvent solution is a rapid drying compound that develops a great deal of tack or stickness and requires pressing the pads into the adhesive within 1 to 2 minutes. Otherwise it becomes too dry to transfer to the second surface. The water dispersed adhesive's paste-like consistency offers a relatively long open time of 1 to 10 minutes. It does not become sticky but because of its high viscosity has a "muddy" type of strength even when

wet, holding the pads in place as soon as bond is made. It is nonflammable during application.

Since fibrous glass pads used on automobile roofs—nearly always at least 1-inch thick—differ only from those used on hoods by being larger and thicker, the two bonding operations are similar. To allow the pad to be repositioned, if necessary, a third adhesive (EC-232) is available for this job in addition to the EC-226 and EC-321. It allows removal and replacement of the pad since its original strength is quite low, just enough to hold the pad in place. It is rapid drying, however, and soon gains in strength.

Busses and trucks are insulated to insure comfort of the driver and passengers and trailer bodies must prevent products in transit from freezing in cold weather or deteriorating during hot weather. House trailers' requirements are a combination of all the foregoing factors.

Light weight and efficiency of fibrous glass pads makes them well suited and widely used for these classes of vehicles. Although the pads are usually hidden behind wall panels, merely pressing them between structural members isn't satisfactory. The jarring and vibration constantly encountered causes unsecured pads to shake loose and change position, affecting insulating efficiency. Not only would mechanical fasteners be difficult to use, but piercing the metal or other backing surface would also cause undesirable appearance. Adhesives again are a simple and sure solution.

The pad is coated with adhesive and pressed into place among and around the structural members. Coating the entire surface insures that the pad will be held firmly and permanently in place wherever it contacts a solid backing of metal, wood, KB board, or other material. Since the adhesive must hold as soon as the bond is made and in most cases should be non-flammable during application, a water dispersed black reclaimed rubber based adhesive (EC-321) is used.

Appliances Are Fertile Field

To insulate automatic clothes washers and driers against heat loss during operation, flexible fibrous glass insulation is used extensively. On washing machines the adhesive used must withstand temperatures of about 180°F. and retain its strength and adhesion under conditions of high humidity. Insulation is pressed into the adhesive within a minute or two after application. The adhesive must hold the pad in place almost immediately. Requirements of good wet strength, very good resistance to water when dry, and the ability to withstand the combination of high heat and humidity without losing strength or adhesion make a water dispersed adhesive (EC-321) ideally suited for the job. Low density fibrous glass pads are used on metal cabinets, refrigerators, and air conditioning units, for insulating, sound deadening, and vibration damping. Metal cabinets usually have only one requirement, that of vibration damping.

Simplest use of fibrous glass pads on refrigerators is as an insulating material between the inner and outer shells where no adhesive or other fastener is needed. However, pads are also used in the unit compartments for both insulating and sound deadening and in this usage are nearly always fastened with an adhesive. Air conditioning units use pads for both insulating and sound or vibration damping. Several types of adhesives previously described (EC-321, EC-1128, and EC-244) are used almost interchangeably in this service. In addition, a water dispersed low viscosity rubber and asphalt adhesive (EC-1025) that has good immediate wet strength, and is easily applied with a brush, is being used successfully.

Fig. 1. Applying high viscosity, fast drying adhesive (EC-244) to hold high density fibrous glass pads used in insulating modern furnaces. Entire surface need not be covered. "Spotting" at intervals of 10 to 12 inches gives the desired results.

A three-fold job is performed by fibrous glass on modern furnaces: it dampens vibration of the thin sheet metal outer jacket, keeps the outer jacket from getting too hot, and eliminates heat loss. Since insulation is rather high density (3 pounds per cubic foot), a heavy bodied adhesive that is rapid drying and has good immediate strength is required. Another important requirement is that the adhesive must be able to withstand comparatively high temperatures without excessive softening or loss of adhesion.

A high viscosity, fast drying material (EC-244) that will not flow up to 250°F. and with sufficient immediate strength to hold the high density pads firmly in place is used for this application. The entire surface need not be covered. "Spotting" at intervals of 10 to 12 inches gives the desired results.

Duct Work Applications Numerous

Flexibility, efficiency, and ease of handling make fibrous glass insulating materials ideal for a wide range of insulating and sound deadening applications in duct-work and piping. Since ducts are made of thin sheet metal, two problems arise: thermal loss and vibration. Both problems are eliminated if fibrous glass is securely fastened to the duct work.

Adhesives give 100% contact between the insulating material and the metal, completely utilizing the vibration damping qualities of fibrous glass insulating pads. Complete utilization of fluffed fibrous glass over the entire area is assured because adhesives eliminated the danger of cutting through the insulating blanket and do not compress the material, no matter how low the density. The need for piercing duct work is eliminated and stress is distributed evenly over the entire pad. Flexible insulation is easily wrapped around duct work. Adhesive applied to the metal holds the insulation permanently in

Fig. 2. In applying faced fibrous glass insulation to concrete walls, a trowel is used to spread adhesive onto back of fibrous glass board.

place as soon as the two surfaces are pressed in contact.

High density fibrous glass insulation (coated with a thin film of rubber to prevent air erosion) is applied to the inside of some high velocity duct work to dampen vibration caused by the air rushing through the sheet metal ducts. Low density material is often applied to the outside of ducts for the same reason. Adhesives are used alone for these operations or in conjunction with such mechanical fasteners as clips, tape, staples, or cord wrapping.

Fibrous glass insulation used for duct work may be plain or faced. Facing materials provide a moisture barrier, a decorative appearance, abrasion resistance and, in some cases, a reflective surface for greater insulating properties.

Adhesives used with fibrous glass insulation must be fast setting, provide good immediate strength, be serviceable through a wide temperature range, and be resistant to moisture, vibration, mold and vermin, and be non-absorbent. Easy application with a brush or trowel is a must. To do this job 3M has developed a light colored, low viscosity material (EC-1128) that offers a long bonding range, immediate strength, easy handling, and a wide temperature range for low density installations. It is extremely flexible and unaffected by high moisture concentrations even at 210°F. High density insulations are fastened with the same mastic or high viscosity material (EC-321) that is used on automobile hoods.

Adhesives Go To Sea

Low to medium density fibrous glass insulation keeps the temperature in shipboard storage and living compartments from building up as the result of the sun beating down on steel plates. Adhesives used to hold insulation in place must be fire retardant or fire resistant when dry. A solvent solution adhesive (EC-890) developed for this application provides the necessary immediate and ultimate bond strength, is rapid drying, and will not burn when dry.

The gain in popularity of metal buildings of the quonset type developed another area where fibrous glass insulation is highly effective and can best be applied with adhesive. Completely set up quonsets can be insulated without the need for loosening bolts or compressing insulation between beams and outside skin of the building. A brush is used to apply the adhesive to the metal surface 2 or 3 feet ahead of the fibrous glass blanket roll. The insulation is pressed into contact and held immediately without having any long tail of insulation lying or hanging in the working area.

Faced insulation if used for this application provides a finished, decorative appearance to the job. Facings usually overlap to give a uniform, unbroken look to the entire surface. The same adhesive used to bond low density insulation to duct work (EC-1128) is used for bonding fibrous glass to the metal shells of quonset huts. It was actually developed for this application although it has many other uses today.

Tank Type Carriers

Railroad tank cars used for carrying various chemical solutions present still another insulation problem that is met successfully by fibrous glass insulation. Temperatures of the solutions carried are kept as high as possible to permit a high concentration. Insulation is placed between the inner liner and outer shell much as in a refrigerator. Application is to the inner shell and the insulation must stay in place while the outer shell is being attached.

Size of the tank car presents a problem since the adhesive is liable to stand open for up to 20 minutes before the blanket is pressed in contact. The bond must also be reliable so that the insulation does not lift from the inner shell while the outer shell is being fastened.

A heavy bodied adhesive (EC-194) with high immediate strength is used for this operation and will provide a good bond up to 20 minutes after application.

Facings Improve Appearance and Insulating Qualities

Certain installations require a facing material on the fibrous glass pad to improve appearance, insulating qualities, or both. There are three main facing materials: aluminum foil, vinyl, and laminated kraft paper.

If a moisture barrier and heat reflector for use at high temperatures (up to 350°F.) is desired, aluminum foil is used. If a moisture barrier only is desired for use at temperatures up to 180-200°F., a kraft paper laminate is employed. If a decorative appearance is needed and the temperature will not exceed 140°F., then a vinyl facing is generally used.

Adhesives used to bond these facings to the fibrous glass insulation must be easily applicable by brush, spray, or roll coat and meet these requirements: (1) For aluminum foil facing the adhesive must be able to withstand high heat and humidity for long periods of time, retain its flexibility, and not deteriorate. (2) For laminated kraft paper facing the adhesive need only be able to withstand temperatures of 200°F. and resist high humidity. (3) For vinyl facing the adhesive may have a low softening point but must not be affected by the plasticizing oils in the vinyl or cause a staining of the vinyl.

To bond aluminum foil facing to fibrous glass, a fire retardant adhesive (EC-890) is used. Two adhesives (EC-321 and EC-1025) are recommended for bonding laminated kraft facings. A water dispersed, roll coatable adhesive (EC-1150) that will withstand the action of

(*Continued on page* 509)

Inventions and Inventors

Annealing and Tempering

Welded Glass Article. Fig. 1. Patent No. 2,643,020. Filed March 4, 1946. Issued June 23, 1953. Two sheets of drawings. Assigned to Corning Glass Works by Robert H. Dalton.

This patent is an adaptation of the principles set forth in U. S. Patent No. 2,642,633. A method is presented of sealing together glass parts which do not require a high degree of manual skill nor the use of complicated sealing machinery. Fig. 1 illustrates a method of applying soft welding glass to the edge of an all glass automobile headlamp known as a "Sealed Beam" head-lamp.

The furnace 10 is swung from an idling position (not shown) into the operating position over the lens 20 so that the stream 17 falls into the groove 19 during one complete revolution of the support 21, after which the furnace 10 is swung aside. This suffices to fill the groove 19 uniformly to a depth less than full and leaves space for the exact registration of a tongue on the rim of the reflector part of the headlamp (not shown) when the reflector is subsequently welded to the lens 20.

The invention possesses a number of advantages but the most outstanding is that hard glasses may be joined at temperature below their strain temperatures. The patent contains one claim and the following references were cited: 2,210,489, Lemmens et al., Aug. 6, 1940; 2,240,352, Schmidt, Apr. 29, 1941; 2,393,448, Armistead, Jan. 22, 1946; 2,417,898, Armistead, Mar. 25, 1947; and 2,464,990, Plagge, Mar. 22, 1949.

Feeding and Forming

Apparatus for Forming a Ribbon of Glass. Fig. 2. Patent No. 2,643,486. Filed December 31, 1949. Issued June 30, 1953. Assigned to General Electric Company by Chester A. English.

An improved apparatus for blowing lamp bulbs is shown in Fig. 2. The invention relates more particularly to a roll construction for the making of a ribbon of molten glass with bosses of a shape and distribution to form desired articles.

A stream 1 of glass in a heated and workable condition issues from an orifice 2 in the bottom of a forehearth 3 and is transformed into a ribbon 4 of suitable proportions to enable bulbs 5 or the like to be blown therefrom. The glass is drawn from a pool 6 within the forehearth 3 under the control of the needle 7 and takes the natural form of the stream 1 until the stream 1 is intercepted by the closely spaced feed rolls 8 and 9 and is therefore reshaped. The pressure of engagement of the feed rolls 8 and 9 spreads the stream 1 into a relatively thin continuous ribbon 4 having concentrations of glass in the form of bosses 10 at regularly spaced intervals. The particular function of the feed rolls 8 and 9 is to form specifically shaped bosses 10 or concentrations of glass at spaced intervals along the ribbon 4 which bosses 10 take positions over the openings 14 in the conveyor plates 12 where they are allowed to sag and finally are blown into bulbs 5 of the character desired.

The rate of flow of the glass stream 1 and the rates of formation and use of the ribbon 4 are so proportioned as to cause an uninterrupted movement in the glass. The volume of flowing glass is also such as to provide sufficient glass to be present to develop the bosses 10 and, accordingly, fill the pocket 15 in the feed roll 9.

The patent contains one claim and the references cited were: 259,203, Picard, June 6, 1882; 1,771,954, Craig, July 29, 1930; 1,790,397, Woods et al., Jan 27, 1931; 1,807,566, Canfield, May 26, 1931; and 1,863,915, Waugh, Jr., June 21, 1932.

Severing Glass. Fig. 3. Patent No. 2,644,274. Filed May 7, 1949. Issued July 7, 1953. Three sheets of drawings. Assigned to the Corning Glass Works by Thomas W. Bailey.

The prime object of the invention is an improved form of apparatus for controlling the connection and disconnection of a source of vacuum-to-vacuum chucks employed in holding the ware during the burn-off operation

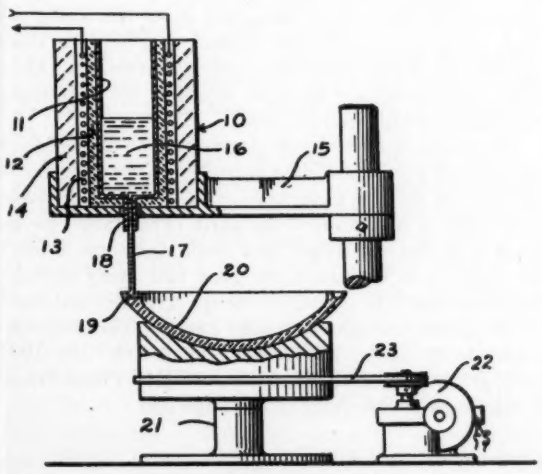


Fig. 1.

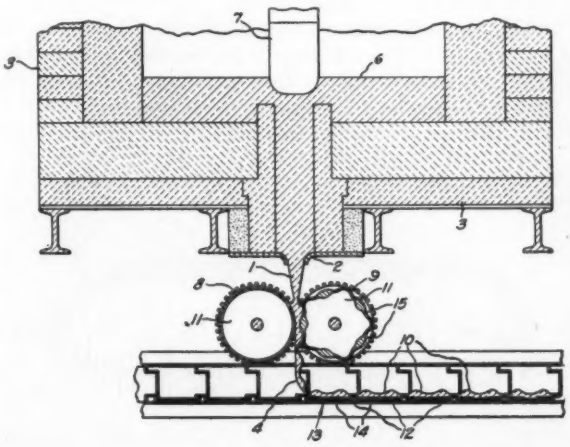


Fig. 2.

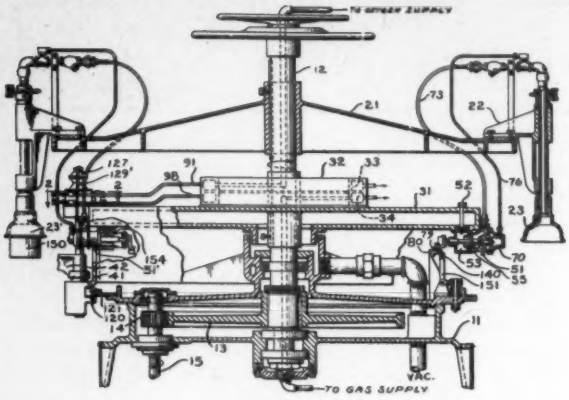


Fig. 3.

and for controlling the connection and disconnection of fuel to the burn-off burners.

The machine as shown in Fig. 3 embodies a base 11 in which is mounted a central supporting column 12, adapted to be rotated by a gear 13 in mesh with a driving pinion 14 carried by a shaft 15 rotatable by a motor (not shown). The upper portion of column 12 has secured thereto a turret 21 having arranged about its periphery a number of brackets such as a bracket 22, each supporting an article chuck such as article chuck 23. Also arranged on column 12 is a vacuum chamber 31 having attached a manifold 32 containing an annular oxygen chamber 33 and an annular gas chamber 34. The chamber 31 on its underside near its periphery is provided with a vacuum control valve assembly, such as the assembly 51 (Fig. 3), for each chuck assembly. The chamber 31 also is provided about its periphery with brackets such as 41, each provided with a burner supporting bracket 42 and a burner 43. Each bracket 41 also supports burner control valves.

The patent contains 11 claims and 11 references were cited.

Glass Compositions

Welding Preformed Glass Parts. Patent No. 2,642,633. Filed March 4, 1946. Issued June 23, 1953. Two sheets of drawings (none reproduced). Assigned to Corning Glass Works by Robert H. Dalton.

This invention relates to the fabrication of glass articles by welding preformed glass parts together and particularly to compositions having special properties which make them suitable as brazing or soldering media for such purposes.

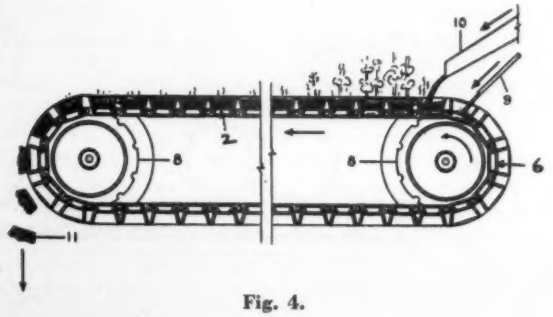


Fig. 4.

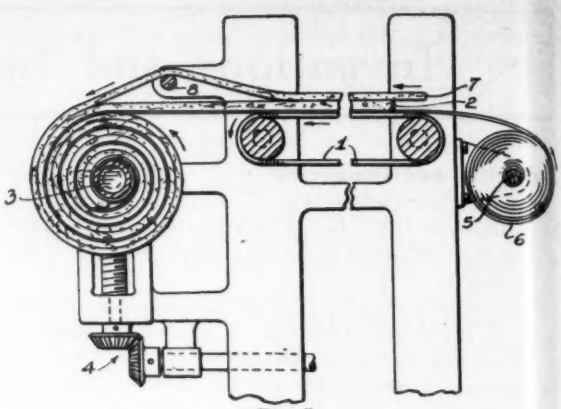


Fig. 5.

The primary object of this invention is to provide a fusion weld between glass parts at lower temperature than has heretofore been possible and without distorting the parts at or adjacent to the weld. The soft brazing glass will, of course, differ in composition from the glass parts to be joined.

The following compositions which are expressed in terms of weight percentage as calculated from their batches generally illustrate glasses which are within the scope of the invention.

	1	2	3	4	5
PbO	75	44	73	65	70
Al_2O_3	11	11	11	10	10
B_2O_3	11	11	11	10	10
SiO_2	3			10	10
PbF_2		28			
CdO			5		
Bi_2O_3		6		5	
NaF					.3
Li_2O					.1
Softening Temp., °C.	440	434	438	496	472
Exp. coeff. per °C. x 10^7	85	84	85	74	78

Composition 1 is particularly suitable for this purpose. In composition 2 part of the lead is introduced as PbF_2, but on the oxide basis the total percentage of lead in this glass is about 71% PbO. In the new glasses the percentage of PbO should not be more than about 17 times the percentage of Al_2O_3 and it will be noted that in the above examples it does not exceed seven times the Al_2O_3. The high alumina content with respect to PbO is a distinguishing characteristic of the present glasses and is higher than was heretofore believed desirable for soft glasses and glazes of high lead content.

The above described soft glasses may be applied to the junction of preformed glass parts in various ways for the purpose of joining such parts with a permanent fusion weld without distortion of the parts. Preferably, the soft glass is melted and flowed in a small stream on to one of the surfaces to be joined, the glass part being heated at least sufficiently to prevent breakage from thermal shock.

The patent contains 20 claims and the following references were cited: 1,793,039, Yetter, Feb. 17, 1931; 2,032,003, Clause, Feb. 25, 1936; and Eitel-Pirani-Scheel: Glastechnische Tabellen (1932), page 708.

Glass Wool and Fiber

Production of Foamed Slag. Fig. 4. Patent No.

2,643, 485. Filed April 26, 1951. Issued June 30, 1953. One sheet of drawings. Assigned to Tennessee Valley Authority by Lee A. Edwards.

This invention relates to improved apparatus for producing expanded or foamed slag, particularly to improved apparatus for introducing steam into molten slag contained in a receptacle.

Fig. 4 shows a number of such receptacles joined together to form an endless chain disposed upon rotatably mounted sprocket wheels 8. A water inlet 9 is disposed to introduce a controlled quantity of water into each receptacle as it is turned into upright position by rotation of sprockets 8. Inlet 9, the loose-fitting heads of plugs 6, and openings 3 (not shown) cooperate to form a means of introducing water into that part of each receptacle below false bottom 2.

In operation sprockets 8 are set in motion and each receptacle passes under water inlet 9. This inlet is of such predetermined size or properly valved so that the amount of water introduced into each receptacle is sufficient to fill the chamber below false bottom 2 and to just cover the false bottom.

Each receptacle then passes in turn beneath slag trough 10 and receives a quantity of molten slag sufficient to substantially fill that part of the receptacle above false bottom 2 when fully expanded. Heat from the slag vaporizes the water below false bottom 2 and steam pressure builds up in the lower chamber. Resulting steam pressure lifts plugs 6 with the result of emitting puffs of steam into the body of molten slag. So long as steam is being rapidly generated in the lower chamber, a violent, rapid, vertical reciprocal motion is imparted to plugs 6, somewhat analogous to the action of the plunger of an air hammer. The introduction of a great number of small puffs of steam from openings evenly distributed beneath the body of slag effectively expands the slag into a uniform foam-like state. The motion of plugs 6 also effectively prevents obstruction of openings 3 by small quantities of hardened slag.

The patent contains two claims and the references cited were: 1,453,735, Twining, May 1, 1923; 1,843,716, Giller, Feb. 2, 1932; 2,061,830, Campbell, Nov. 24, 1936; and 2,428,249, Stuart et al., Sept. 30, 1947.

Method of Producing Batts of Silica Fibers. Fig. 5. Patent No. 2,643,487. Filed March 23, 1951. Issued June 30, 1953. Two sheets of drawings. Assigned to the H. I. Thompson Company by Leon Parker.

The above patent is an extension of Patent No. 2,491,-761 issued to Leon Parker et al. It provides an improved method of fabricating silica fibers suitable in fabricating insulating blankets.

In Fig. 5 the mandrel 3 is rotated by suitable gearing. A roll of plain crinkle-free paper 6, mounted on a suitable rotatable mandrel 5, is unwound and passed via conveyor 1, and about two layers of paper are wound on the mandrel 3. Two layers 2 and 7 of batt were laid on top of each other on the continuous length of paper with the bottom layer extending a short distance ahead of the top layer. The top batt was guided over a freely rotating rod 8 which was fixed above the batts and back from where the two batts meet just before going on the core. When the lengths of batt were completely wound on the core, additional layers of paper were wound upon the exterior of the roll to hold the batts in position. The batts wound upon the mandrel are removed from the machine. The roll of material on the core is then sent to the heat treaters. The core is left in so that in packing the rolls in boxes and in transporting the boxes, the rolls of material are not crushed by their own weight. The cores are removed just before the rolls are placed on the trays 9 of the furnace 10 for firing (not shown).

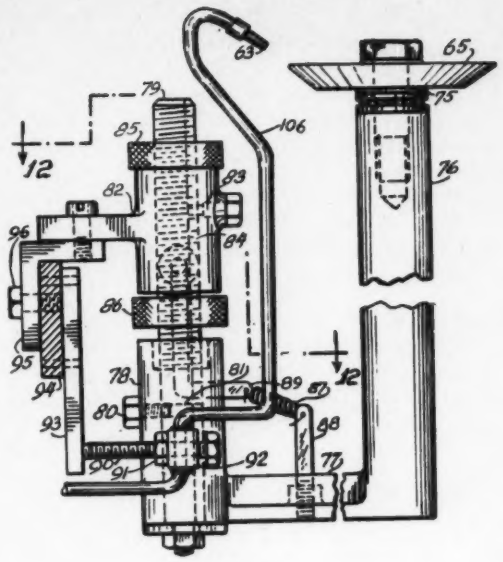


Fig. 6.

It is desirable to heat the batts rapidly to 1800°F. in order to dehydrate the siliceous fibers and hydrated glass into the desired insulating batt.

The patent contains five claims and the references cited were: 2,171,006, Morgan, Aug. 29, 1939; 2,318,243, McClure, May 4, 1943; 2,428,653, Collins, Oct. 7, 1947; 2,518,744, Barnard, Aug. 15, 1950; 2,526,870, Jelinek, Oct. 24, 1950; and 2,565,941, Barnard, Aug. 28, 1951.

Tube and Cane Machines

Crack-off of Glass Tubes. Fig. 6. Patent No. 2,641,870. Filed December 6, 1950. Issued June 16, 1953. Three sheets of drawings. Charles Eisler.

An improved machine for cracking off tubes is described. The invention provides for continuous automatic cracking off of glass tubing to desired pre-determined lengths without the necessity of stopping the operation for indexing or similar purposes.

The complete disc crack-off tool is shown in Fig. 6. It comprises disc 65 on ball bearings 75 journalled in support of 76 which is integrally connected by bracket 77 with sleeve part 78, the latter being freely rotatable on shaft 79. When making contact with the glass tube, the disc 65 swings resiliently responsive to coil spring 87 connected to pin 88 of swinging bracket 77 and pin 89 in the fixed main bracket 82. The back swing of disc 65 limited by adjustable screw 90 having jam nut 91, which is threaded in arm 92 of sleeve 78. The screw 90 bears against the stop member 93 secured to circular rail 94 to which main bracket 82 is secured. The disc air-cooling nozzle 63 and its duct 106 are mounted on arm 92 of sleeve 78, so that, during the swing of the disc, the nozzle 63 will remain in correct relation.

Gas-oxygen burners (not shown) for heating the tubes

prior to cracking off are lit by pilot flames. The complete machine is provided with sixteen chucks—every four positions yielding one crack-off, or a total of four crack-offs for every revolution.

The patent contains one claim and the following references were cited: 684,686, Grotz, Oct. 15, 1901; 894,019, La Clare, July 21, 1908; 1,546,352, Rippl, July 14, 1925; 2,169,455, Wagner, Sr., Aug. 15, 1939; 2,297,149, Houck et al., Sept. 29, 1942; 2,410,931, Eisler, Nov. 12, 1946; 92,761, Germany, July 12, 1897; and 288,197, Germany, Oct. 23, 1915.

Miscellaneous Processes

Realigning Apparatus. Fig. 7. Patent No. 2,637,943. Filed March 9, 1950. Issued May 12, 1953. Three sheets of drawings. Assigned to Corning Glass Works by Francis R. Painter.

The apparatus shown in Fig. 7 provides a means of realigning an element sealed into a wall of a glass article while the glass adjoining the element is still in a workable condition following the sealing operation. The equipment is specially adapted to sealing an electrical conductive element or "button" in cathode-ray tubes.

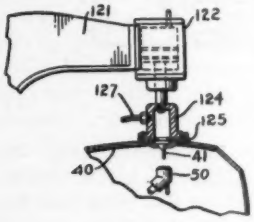


Fig. 7.

The button-aligning equipment also includes a bracket 121 provided with a differential-pressure pneumatic unit 122 similar to the unit 37. It is also equipped with a vacuum bell 124 adapted to be lowered by the unit into engagement with a tube 40 and over a sealed-in button, such as button 41, aligned whenever fluid is supplied to the upper end of the unit. Vacuum bell 124 is activated by connection of a vacuum source at the proper time to pneumatically lift the button and the surrounding softened glass to their original position with respect to the unsoftened glass of the tube wall. A face plate 125 on bell 124 initially spaced from the button 41 prevents the button being lifted above the desired position.

The patent contains two claims and the references cited were: 2,059,767, Bausch, Nov. 3, 1936; 2,398,525, Gray, Apr. 16, 1946; 2,410,345, Hinkley, Oct. 29, 1946; 2,485,769, Phelps, Oct. 25, 1949; 2,492,162, Litton, Dec. 27, 1949; and 2,494,870, Greiner, Jan. 17, 1950.

Multifocal Lens. Fig. 8. Patent No. 2,640,299. Filed December 7, 1949. Issued June 2, 1953. Assigned to the American Optical Company by Samuel T. Sheard and Louis F. Rowe.

A novel and improved method is presented for making bifocal and multifocal type lenses.

Referring to Fig. 8 it is important to know that the glasses of the major portion 7 and the filler portion 11 are of substantially the same melting point and respond to heat sooner than the segment portion 8. Portion 11 will therefore drop first to assume the shape of the countersink curve. Portion 8 will next move to assume its desired contour. Wedge 14 retards this movement in order that all entrained air may first be squeezed from the contact area.

Due to the fact that the spacer or wedge 14 then follows the portion 11 in its response to the fusion temperature and will thereupon soften and allow the portion 8 to drop

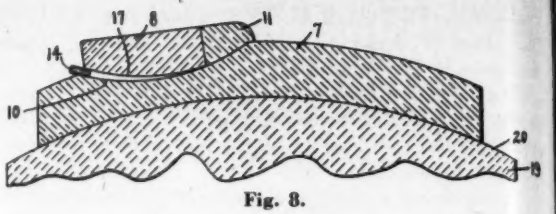


Fig. 8.

into engagement with the adjacent surface curvature of the countersink 10, air and gases will be automatically driven out from between the interfaces.

Glasses 7 and 11 are of substantially the same composition, index, and same melting point; hence very little, if any, gases will be evolved throughout the interfaces and the glasses will join into a homogeneous structure whereupon the upper curve of the countersink, illustrated by the dash line 18, (not shown) will disappear.

The patent contains three claims and 10 references were cited.

Electrically Conducting Safety Glass. Patent No. 2,640,904. Filed August 10, 1950. Issued June 2, 1953. One sheet of drawings (none reproduced). Assigned to Libbey-Owens-Ford Glass Company by Romey A. Gaiser.

The above invention relates to laminated safety glass, and particularly to electrically conducting laminated safety glass.

Failures encountered in electrically conducting laminated safety glass are due primarily to bending of the unit due to the temperature differentials at the several surfaces and the difference in coefficient of expansion and contraction between the glass and the plastic interlayer.

Bending of the electrically conducting laminated glass unit can be reduced, if not entirely overcome, (1) by placing an electrically conducting film on each of the glass faces that lie against the plastic interlayer, or (2) by locating the electrically conducting film approximately midway between the inner and outer surfaces of the unit, and also the degree by proper positioning of the film or films in the unit. With this type of structure, electrode failure and edge separation from excessive bending even under the most extreme temperature conditions is eliminated.

The patent contains one claim and 16 references were cited.

KIMBLE GLASS ERECTS NEW WAREHOUSE

A new warehouse to be used for storage of all-glass television bulbs, under construction at the Kimble Glass Company's plant in Columbus, is scheduled for completion about October 15.

The new warehouse will occupy an area 365 feet by 650 feet just southeast of the plant. A one-story construction with metal siding, it will provide 200,000 square feet of floor space.

Access to transportation will be supplied by a truck dock at the northern end of the building and by a spur line from the tracks of the New York Central Railroad which will extend into the building along the entire west side.

• R. F. Mensing, comptroller of Glass Fibers, Inc., has been re-elected a director of the Toledo Control of the Controllers Institute of America.

SILICA BRICK AND THE NEW HARBISON-WALKER PLANT AT WINDHAM

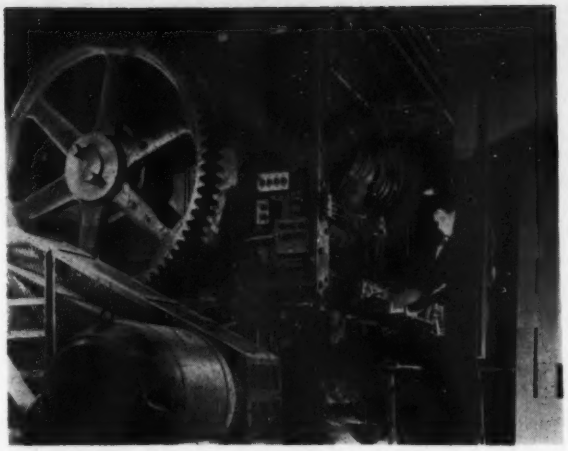
Silica refractories are a vital necessity to the glass industry, but the glass industry is by no means the largest consumer. It appears that the glass industry uses only about five per cent of the silica brick produced in this country, while the open-hearth steel furnace and the by-product coke oven use some ninety per cent. Smaller amounts go to the copper and other industries, but the steel industry is the large consumer.

This does not mean that at any instant there are eighteen or nineteen times as many silica brick in use in the steel industry (including coke ovens) as in the glass industry. There are not, because the steel industry consumes or destroys its silica brick much faster than the glass industry.

The raw materials suitable for the manufacture of silica refractories generally occur in limited areas. Since the brick itself is a comparatively heavy product, freight charges bulk large in the costs of the delivered product. Hence it is natural to try to locate silica brick plants close to the customer, and to try to locate them where they will also be handy to a satisfactory source of silica rock. And since the principal consumer is the steel industry, the location of the steel mills of the country should logically determine the location of silica brick plants. It is, therefore, somewhat surprising that it is only within the last year or so that a sizable silica refractories plant has been established near Youngstown, Ohio, for here, at the Pennsylvania-Ohio line, in Sharon, Pennsylvania, Youngstown, Ohio, and neighboring points, is a very substantial fraction of the steel industry. Within sixty miles of Windham, Ohio, site of the new Harbison-Walker plant, is some 22% of the total United States production of steel, and within one hundred miles there is 40% or more of it. Also in the same area there is a large production of many types of glass. And within a few miles of the site there are outcrops of the Sharon Conglomerate, of Mississippian (Lower Carboniferous) age, which locally provides a very suitable raw material.

The plant has been designed on a highly mechanical basis, and with very elaborate precautions to protect the employees from the principal hazards of the industry, so that on humanitarian grounds, as well as economic ones, a high investment per employee and elaborate mechanization are justified.

The capacity of the plant is roughly 90,000 tons per year, which converted into an equivalent number of standard brick is 30 million or so, or about 3,000 carloads. The production consists of both the usual standard sizes and of many special intricate shapes. Labor shortages and comparable factors have delayed the plant's reaching full capacity, but brick have been shipped for approximately twelve months past.



Power press in operation.

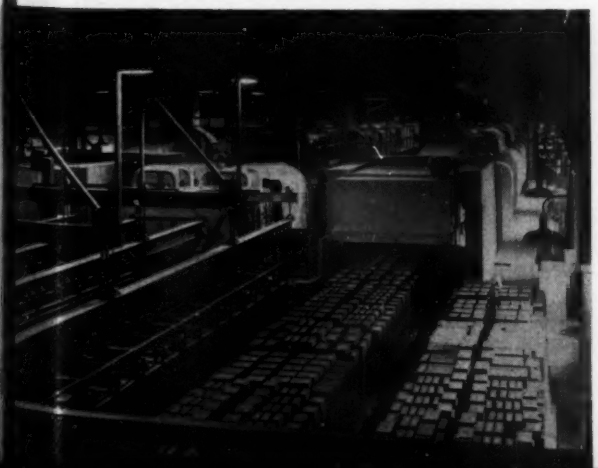
The plant makes both regular "Star" brick and the super-duty quality known as "Vega." "Star" silica brick have been manufactured by Harbison-Walker since 1886. "Vega" is a brand name the company adopted in 1942 for the first super-duty silica refractory. The company does not explain the name, but since all amateur astronomers and airplane and ships' navigators know that Vega is a star of the first magnitude, it seems apparent that the company is still hitching its wagon to a star.

Some discussion of the properties of modern silica (and other) refractories appears in THE GLASS INDUSTRY for April 1949 under the title, "Refractories for Glass Furnaces" by W. F. Rochow. Nowhere, so far as we can discover, is a complete account available of how physical factors, as distinct from chemical composition, affect the bricks. Thus all sources of raw material, quartzite, ganister, vein-quartz, quartz conglomerates, and the like do not give identical results after processing, and some very pure silica materials cannot be used for making refractory brick. The manufacture of a first-class silica refractory involves much more knowledge than appears in equilibrium diagrams.

The construction of the new plant was urged by the United States Government as a defense measure. While it is of greatest importance to the steel industry from the point of volume, the Windham plant is also an insurance of proportionate importance to the glass industry.

F. W. Preston

Foreground: Unburned brick entering kiln car dryer. Left: Monorail tracks at entrance end of "rack car dryer."



L-O-F APPOINTMENT

James E. Baskin, with more than 15 years' experience in the fiber glass field, has joined the product development section of the Fiber Glass Division of Libbey-Owens-Ford Glass Company. Mr. Baskin will work closely with Herbert A. Fox, Technical Manager.

A native of Tennessee, Mr. Baskin has been in Dayton, Ohio, the last three years in fiber glass sales. His previous experience spans the whole period of development of fiber glass.

Machines for the Fabrication of Glass Containers

The Society of Glass Technology recently held a symposium on machines for the fabrication of glass containers and the discussion is reported in the April 1953 issue of their *Journal*.

A communicated discussion by W. R. B. Frank on this subject contains much constructive criticism that should be useful to American users of glass forming machinery.

"(1) *Materials.* The ultimate object of most of the mechanisms used is to move molds. A mold which moves is often brought to rest abruptly, and the machine has to withstand shock. Consequently, machine parts are made massive. Massive moving parts must be carried on massive frames, and the process builds up through the machine, until finally we have a structure which weighs tons. Yet it handles only a few pounds of mold. The position is made worse by the use of cast iron for many moving parts.

"Welded or forged-steel construction may be more suitable than cast iron, and the sections needed to carry the loads are ridiculously small. For example, in a turnover for a large machine, carrying over 6 cwt., it was calculated that a ¾-in. diameter spindle would be quite satisfactory. No one would believe this, so the diameter was doubled, and a 1½-in. diameter spindle used. This should be compared with the 4-in. diameter spindles on cast-iron turnover drums in certain types of automatic machines, where molds weigh only 40 lb. or so.

"Frames of machines would be far cheaper when constructed in welded steel. Massive frames would not then be necessary. The wheelbarrow used to transport a set of molds to the machine probably carries more shock loading than the machine frame. Standard sections may be used. A further advantage of welded steel construction is that modifications are easily made, as this involves simply welding extra parts on. Rigidity is greater than with cast iron or malleable iron, and the structure may be bent, but seldom breaks. Welded designs must not be copies of cast-iron parts, or the cost will be greater. A new approach is necessary in order to use existing standard sections.

"(2) *Power to Drive Machines.* Often machines start and stop abruptly, and energy is lost at each stop. It is possible to design many moving parts, so that the kinetic energy is stored by means of springs, or by a gain in potential energy. The power necessary is thereby reduced. The weight reductions following the use of steel construction would reduce friction and power loss.

"(3) *Standard Components.* Many of the components used in glass blowing machines are quantity produced in standard sizes. Examples are hard steel bushes and bronze bushes. There is no need for bushes to be specially designed for glassworking machinery, and the quality of the mass-produced article is better. Maintenance costs are reduced, and machines may be returned more quickly to production, since these standard parts are available 'off the shelf.'

"Self-lubricating bushes are very useful. It is possible to build up machines for other purposes which require very little oiling, and which can be run for months with no maintenance attention so far as lubrication is concerned. Centralized pump lubrication can take care of the few points where self-lubricating bushes may not be used. Self-lubricating bushes are available for use at high temperatures.

"Standard compressed-air components, chain drives, locating pins and bushes, shock absorbers, reduction gears, etc., are all available. In one machine, for example, a lifting device was replaced by a car jack, which was in fact a far better article than could have been produced at four times its price. The automobile and aircraft industries have standardized many components and mechanisms which may be used. As an example, hydraulic operation of furnace parts should be considered. The equipment is reasonable in price, of the highest quality and reliable.

"Air is used for three purposes. These are glass blowing, operation of mechanisms, and cooling. It is usual to employ the same supply for blowing and machine operation. Compressed air is sometimes used for localized cooling, but it is recognized that the practice is wasteful, while fans are used for the supply of cooling air. The operation of mechanisms is best performed at air pressures over 100 lb./sq. in. Blowing of glassware needs only about 20 lb./sq. in. maximum, whereas cooling-air pressures are measured in inches w.g. In glassworks practice, a compromise has been made between requirements for blowing and machine operation. This results in disadvantages on both sides.

"(1) *Blowing Air.* For this purpose, pressures are used which are higher than is necessary. The quantities of air are appreciable, especially since leakage past neck-ring location faces cannot be avoided. It would be very useful to carry out tests on air requirements for blowing, so as to decide the maximum pressure necessary. It might then be advantageous to use a separate air supply at this pressure for the following reasons: (*a*) Costs are reduced. The air is compressed only to the pressure required. (*b*) The blowing demand does not cause fluctuations in pressure for machine operation. (*c*) Machine operation is possible at higher pressures. Rotary type compressors are available for low pressures, and are cheaper in first cost and running costs than reciprocating compressors.

"(2) *Machine Operation.* A pressure of 150 lb./sq. in. is far more suitable than the low pressures normally used. The advantages are: (*a*) The volume of air is reduced considerably. There is a negligible pressure drop in pipe-lines and connections, and operation is far more reliable. (*b*) The sizes of operating cylinders are reduced. The reduced masses of moving parts, coupled with the higher pressures and reduced pressure losses in supply line, result in more rapid operation when this is required; for example, in the operation of mechanisms for transferring articles on and off conveyors. (*c*) Standard air equipment may be used. This equipment is cheap, and far better made than is possible with the usual facilities

available in a glassworks machine shop. All the operations performed in the glassworking machines may be performed by standard equipment, which includes cylinders in all sizes, all types of valve, relay valves, cam-operated valves, flexible connections, piping, and pipe fittings for rapid assembly. Standard air equipment is available at reasonable delivery times. A small number of standard parts may be stocked by the user, and will meet all his needs. The load on his own machine shop is accordingly reduced. Modifications to the machines are made more easily and cheaply by the manufacturer or user. Special-purpose devices may be rigged up quickly without the need for special parts.

"(3) *Cooling*. Compressed air should never be used for cooling. It is not difficult to calculate the cost of such cooling, and this cost is fantastic for the service performed. An adequate volume of fan-air, with ducting and nozzles designed properly, will give efficient cooling much more cheaply. There seems to be a great need for the personnel in charge of machines to be educated in the simple principles of air supply and use.

"Most of the energy put into fan-air by the fan is wasted in the pipes between the main duct and the points of application. These pipes should have diameters at least twice what appears to be the customary practice in many glassworks. If space permits, such ducts should terminate in stream-lined nozzles on the same lines as those used by fire brigades for water. When more air is required, a larger nozzle is used; when less, a smaller nozzle. Dampers to control air flow waste most of the energy available. A stock of clip-on nozzles could be kept for different requirements. When the limit of the fan is reached, another fan should be installed for fans which are expected to deliver more than their rated capacity fall off rapidly in efficiency.

"Where air requirements do not vary appreciably, or where part of the load is constant, an axial-flow-type fan is more efficient than a centrifugal type, but at low loads it is wasteful.

"Molds are operated at as fast a rate as possible, chiefly to take the maximum amount from a feeder with the least capital expenditure on machines and on sets of molds. It may be noted in passing that in these days of copying devices and machine tools, which may be set up for cheap repetition, it is not certain whether or not it really is cheaper to use a smaller number of molds at higher speeds, or vice versa. Despite these theoretical considerations, it is obvious that users will always desire to push machines to the limit, and so the question of cooling arises.

"The next item to be considered, from the theoretical point of view, is the need for cooling. Does the glass need to be cooled down so much in the parison mold? Would it be possible to shoot the glass in and out so quickly that it hardly warmed the mold, and in such circumstances how would it blow in the blow mold? These points are mentioned as a reminder that we must not assume that the way things are done now is necessarily the best way. We may be making rods for our own backs by adhering to established procedures and speeds. What happens, for instance, when glass is blown at explosive speeds?

"Assuming that cooling is necessary, then how can it be performed to reduce expense? The important point to grasp appears to be that the most efficient way of cooling an object is to increase its surface area. It is also the cheapest. When natural convection is compared with low-velocity fan-air, it is found that fan-air gives an appreciable increase in loss of heat. Further improvements are obtained only by increasing the velocity of the cooling air, which raises the cost considerably. For example, if the velocity is doubled, the rate of heat loss is increased by a factor of 1·52, but the horse-power needed to provide the air is increased by a factor of eight, and so is the cost of power. This calculation assumes no change in mold-surface temperature. If the surface temperature falls, the factor will be smaller.

"On the other hand, if the surface area of the mold is doubled, the cooling is doubled for no extra expense at all, except that the molds may cost a little more. The area may be increased by increasing the outside diameter of the mold. It may be increased far more by finning. Vertical fins must be used for much of the cooling is due to convection and the air will not go into the space between horizontal fins. The fins must also be narrower in the lower parts of a mold since the hot air rises and blankets the top. The aim is to reduce the cooling at the bottom and increase it at the top by broadening out the fins. Mold-holders which effectively insulate molds must be replaced by holders which allow free access of air to as much of the mold surface as possible.

"When finning on these lines is used, mold temperatures are considerably reduced and fan air may not be necessary in many cases. Molds take longer to warm up, and in some processes it may be advisable to provide them with tin covers to prevent cooling until they reach the working temperature.

"Mold materials play a part in cooling. Cast iron has so far proved most satisfactory, and this is not surprising when its diffusivity is compared with values for bronzes and heat-resisting steels.

"Observation of parisons will show that the parts near the finish and the finish itself are the coolest. The air which absorbs the heat from the lower parts of the mold rises and is not so effective in cooling the top. In some cases it may be advantageous to insulate the lower parts of the mold, and to use lower-conductivity materials for the neck rings. An attempt to measure baffle temperatures might be useful. A baffle may run at a much lower temperature than the mold, which is one of the reasons for the cracking of bottles at baffle marks. In some cases the baffle may even have to be insulated to overcome this.

"Careful observation has suggested that with the thicknesses of molds commonly employed, lugs do not noticeably affect the cooling. More detailed measurements are necessary since under limiting conditions the effects of lugs may be important. It is surprising that these massive lugs do not seem to cause cold spots on the parison surface."

MARIETTA CONCRETE NAMES CONSULTING ENGINEER

The appointment of John R. Snowball as consulting engineer to The Marietta Concrete Corporation has been announced by Frank L. Christy, President.

Mr. Snowball has been associated with the Portland Cement Association as housing and products engineer.

LYNCH-OVERMYER GLASS CLINIC

Announcement of the Lynch-Overmyer Glass Clinic to be held September 23 and 24 has been made.

Activities on September 23 will be sponsored by Lynch Corporation as its 35th Anniversary Clinic. From 9:00 A.M. to Noon, the program includes registration, tour of plant, mold book discussion, and new developments and maintenance discussion. The afternoon's program includes demonstration of new machines, customer's forum, visit to Lynch foundry, a cocktail party at 6:30 P.M., and a banquet at the Edgewood Country Club. At the banquet, Dr. L. G. Ghering will address the gathering.

On September 24, when Overmyer Mould Company will be guests at the Fifth Annual Iron Clinic, the program includes registration and a visit to the Overmyer foundry. At 9:30 A.M. the Iron Clinic will be in session and will include a general discussion of developments in glass and mold metallurgy, a general discussion on proper care, repair, and cleaning of mold equipment, and a discussion of the Colmonoy Process. Luncheon will be followed by a golf tournament in the afternoon. A cocktail party at 6:00 P.M. will be followed by a banquet at the Beeson Park Club House.

BOOK REVIEW

Opportunities in Ceramics

By Samuel R. Scholes

This book is one of over forty vocational guidance manuals intended for high-school guidance officers and anyone else interested in the subjects listed. New titles are being added to this useful set of books.

This manual, Opportunities in Ceramics, would have justified its writing if considered only from the value of the material offered in Chapter I. Ceramics here is defined, pronounced, and given a brief historical review. The word is so often misunderstood, mispronounced, and defined incorrectly that at times there is confusion in the minds of some industrialists. Never again will the reader believe a certain encyclopedia which says tersely, "ceramic or ceramics, a general term for the history and art of making pottery."

The reader then learns of the economic advantages offered in this profession and some of the aptitudes required of him.

There are chapters that describe the raw materials used in ceramics and the various branches of the industry, as well as the industries allied closely to ceramics. The work of the ceramic engineer, the ceramic technologist, the glass technologist, and the industrial ceramic designer is described, and the job opportunities in each field are considered.

The final chapters are important to the prospective student because he finds what attributes are necessary for success in this work. The informal style of the writer helps to clarify these qualities, which he describes as: "numbers sense; curiosity about machines and materials, structural visualization; words (a curiosity which builds a necessary technical vocabulary): interest in materials; and artistic ability." A description is also given of what is meant by a "ceramic education" and then how to get a job.

The work of the American Ceramic Society is outlined and a number of basic books on ceramics is listed.

The style is simple and the language is intimate and friendly. The chapters are broken into subdivisions with headings, which are listed in the Table of Contents and in the subject index. In spite of its simplicity, however, the pages are filled with the wisdom of the writer, who has been able to give of his forty years of experience in teaching and writing in ceramic science and industry, particularly in glass technology.

The manual has much of interest and value to the college freshman, even after he has chosen ceramics as his course of study, and it should be required reading for every high-school senior, both boys and girls. Moreover, the general reader will also find it informative and useful.

In differentiating between the ceramic engineer and the ceramic technologist, the author has written a half-serious verse, which ends with these lines:

Science may prove clay's chemistry;
"What is the breaking stress?" says he.
Technologists find why and how;
The engineer must do things now.

Published by Vocational Guidance Manuals, Inc., New York, 1953, 96 pages, paper bound. Price $1.50.

A.C.S. PACIFIC COAST REGIONAL MEETING TO BE HELD IN OCTOBER

The Sixth American Ceramic Society Pacific Coast Regional Meeting is scheduled to be held October 22 through 24 at the Palace Hotel in San Francisco, California.

Papers to be presented at the Glass Sessions include "Alkali Determination by Flame Photometry," Wolfram Seitz, Glass Containers, Inc.; "Color Changes in Continuous Glass Melting Furnaces," A. R. Cooper and A. K. Lyle, Hartford-Empire Company; "Turbulence in a Glass Tank," Larry Penberthy, Penberthy Instrument Company; "The Shoe on the Other Foot," F. W. Preston, Preston Laboratories; "Optical Methods for Determination of Iron in Glass Sands," Robert J. Campbell and James I. Mueller, University of Washington.

At the Glass and Refractories Sessions, papers to be presented include "The Use of Clay Flux Blocks," J. J. Duggan, Walsh Refractories Corporation; "Basic Refractories in the Glass Industry," J. C. Hicks, Kaiser Aluminum & Chemical Corporation; "Report on Fused Cast Bottom Paving," Harold W. Baque, Corhart Refractories Company; "Comparative Tests on Fireclay and Pumice Concrete," W. O. Brandt, Gladding, McBean & Company.

CORNING DEVELOPS PRISMATIC GLASS PANEL

A new prismatic glass panel for fluorescent lighting fixtures has been announced by Corning Glass Works. Known as Pattern No. 70, Low Brightness Lens Panel, it is designed to deliver a maximum amount of light in the useful zone and reduce brightness in the glare zone.

Brightness is controlled by an attractive and functional pattern of six-sided pyramidal prisms, with the water-white crystal permitting highest light transmission without distorting the color of the transmitted light.

Light in weight, the panels are available in lengths up to 100 inches, and widths up to 24 inches. They are particularly suited for luminous elements, troffers, and fixtures where low brightness is essential.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during June 1953 was as follows: *Flat Glass:* A preliminary 30,900 persons reported, which is a drop of 1.2 per cent from the adjusted figure of 31,300 persons employed during May. *Glass and Glassware, Pressed and Blown:* A preliminary 92,200 persons employed representing an increase of 1.9 per cent over the previous month's adjusted figure of 90,400. *Glass Products Made of Purchased Glass:* A preliminary 14,600 employed persons was reported, which is .6 per cent under the 14,700 persons employed during May.

Payrolls in the glass industry during June were as follows: *Flat Glass:* A preliminary $13,082,030, which is 4.7 per cent below the adjusted payrolls of $13,736,944 for May. *Glass and Glassware, Pressed and Blown:* Preliminary payrolls of $27,419,973 reported, which is 1.6 per cent higher than the adjusted May payrolls of $26,970,840. *Glass Products Made of Purchased Glass:* A preliminary $3,709,325 representing a drop of 1.1 per cent from the adjusted $3,753,204 reported for May.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

	July, 1953
Narrow Neck Containers	
Foods	824,206
Medicinal & Health Supplies	866,167
Chemicals, Household & Industrial	692,805
Beverages, Returnable	1,013,680
Beverages, Non-returnable	113,415
Beer, Returnable	455,890
Beer, Non-returnable	937,485
Liquors	676,227
Wines	224,491
Toiletries & Cosmetics	536,870
Sub-total (Narrow)	6,341,236
Wide Mouth Containers	
Foods	*2,605,000
Dairy Products	234,199
Medicinal & Health Supplies	261,286
Chemicals, Household & Industrial	100,898
Toiletries & Cosmetics	127,798
Packers' Tumblers	159,698
Sub-total (Wide)	3,488,879
Total Domestic	9,830,115
Export Shipments	231,239
TOTAL SHIPMENTS	10,061,354

* This figure includes Home Canning.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production July 1953	Stocks July 1953
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	6,714,259	6,532,395
	Wide Mouth	*3,871,647	*4,113,271
Dairy Products		237,863	308,131
Beverages, Returnable		963,621	827,857
Beverages, Non-returnable		112,953	91,082
Beer, Returnable		429,973	177,535
Beer, Non-returnable		969,121	523,543
Liquors		730,379	820,602
Wines		231,513	302,848
Packers' Tumblers		184,437	173,030
TOTAL		10,585,906	10,645,666

* This figure includes Home Canning.

Glass container production, based on figures released by the Bureau of Census, fell off during July to reach 10,585,906 gross. This is 2.4 per cent under the 10,850,400 gross produced during June. During July 1952, production was 10,042,384 gross, which is 5.4 per cent less than for July this year. At the end of the January-July 1953 period, glass container production has reached a total of 71,718,848 gross. This is 7 per cent higher than the 66,988,169 gross produced during the corresponding period in 1952.

Shipments of glass containers during July were 10,061,354 gross. This represents a drop of 3.5 per cent from the 10,420,615 gross shipped during June. During July 1952, shipments of glass containers were 9,938,018 gross, or 1.2 per cent less than for July this year. At the close of the January-July 1953 period, glass container manufacturers have shipped a total of 70,478,567 gross. This is 6.9 per cent above the 65,908,854 gross shipped during the corresponding period in 1952.

Stocks on hand at the close of July 1953 were 10,645,666 gross, which is 3.7 per cent higher than the 10,261,051 gross on hand at the end of June, and 5.3 per cent higher than the 10,106,700 gross on hand at the end of July 1952.

Automatic tumbler production during the month of July 1953 was 3,861,007 dozens. This is 27.1 per cent below the 5,296,383 dozens produced during June. Production during July 1952 was 4,965,904 dozens. Shipments during July rose 2.7 per cent to reach 4,930,961 dozens. This is an increase over June shipments of 4,800,045 dozens. Shipments during June 1952 were 5,244,624 dozens. Stocks on hand at the end of July 1953 were 9,952,927 dozens. This is 10.2 per cent less than the 11,088,567 dozens on hand at the end of June. Stocks at the end of July 1952 were 8,023,263 dozens.

Table, kitchen, and household glassware: Manufacturers' sales of machine-made table, kitchen, and household glassware during July 1953 were 2,739,148 dozens. This is only slightly below the 2,740,816 dozens sold during June. Sales during July 1952 were 2,944,891 dozens. At the end of the 12-month period ending July 1953, manufacturers have sold a total of 41,533,964 dozens. This is 6.6 per cent higher than the 38,954,270 dozens sold during the same period in 1952.

• The Clark Equipment Company has established a $2000 scholarship fund at the Illinois Institute of Technology for students majoring in materials handling, Dr. Ralph G. Owens, Dean of Engineering, has announced.

New Equipment and Supplies

COMBINATION OXYGEN-COMBUSTIBLES ANALYZER

Bailey Meter Company, 1050 Ivanhoe Road, Cleveland 10, Ohio, has announced a completely new combination oxygen and combustibles analyzer providing vital operating information on combustion performance. This gas analyzer can help save fuel dollars, especially where multi-fuels or fuels of varying composition are fired, and act as a safety guide to prevent the lighting off of unpurged, gas-fired combustion chambers.

Analyzes of $\%O_2$ (an index of excess air) and % combustible (an index of fuel-air mixing performance) are offered for the first time in a single, compact unit. The gas analyzer and its recorder indicate or automatically control the necessary adjustments required to maintain maximum combustion efficiency within combustion equipment limitations.

Features of the analyzer include minimum range, O-5%; maximum range, O-25%; uses compressed air and H_2 for catalytic combustion; noble metal filaments with thermal conductivity compensators are part of null balance bridges; accurate with ± 0.25% by volume of O_2 and combustibles contents in sample.

AUTOMATIC REVERSAL SYSTEM

Askania Regulator Company, 240 East Ontario Street, Chicago 11, Illinois, has introduced a new packaged automatic reversal system for open hearths, regenerative soaking pits, and glass tanks.

The system features a compact panel in which the reversal controls are factory-assembled. Reversal can be initiated automatically by elapsed time or checker temperature, or semi-automatically by push button, as desired.

The Askania system provides unvarying reversal sequence, with all steps electrically interlocked for safety. Fast reversal and better utilization of checker heat mean greater furnace efficiency. Panel lights indicate firing conditions and reversal sequence. Pistol-grip switch gives operator control.

VERTICAL SCALE INDICATOR

Minneapolis-Honeywell Regulator Company, Industrial Division, Wayne & Windrim Avenues, Philadelphia 44, Pa., has announced the development of a compact vertical scale electronic indicator. Especially designed for applications where panel space is limited, the new instrument is expected to be widely used in the chemical, aircraft, central station, marine, and petroleum industries. Only six and one-half inches wide, the instrument saves 60 per cent of the space formerly required by a conventional model indicator.

The principal feature of the new instrument, called the ElectroniK Vertical Scale Precision Indicator, is the rotating scale with fixed index. The scales are illuminated, with black numbers and division lines on a white drum. Twin hairlines, used for close observance, prevent parallax errors.

PRECISION COLORIMETER

Instrument Development Laboratories, 163 Highland Avenue, Needham, Mass., has announced the redesigning of the Model "C" Color-Eye for industrial color measurement and comparison. A comparison colorimeter of high sensitivity and precision, Color-Eye computes logarithmically to simulate the response of eye and brain. Tristimulus type filters permit measurement under daylight or artificial sources.

The standard instrument can be furnished with either diffuse (sphere-type) or 45° normal illumination and viewing, with illuminators interchangeable if desired. Up to 15 filter combinations can be installed in one instrument, including narrow-band interference-type for abridged spectrophotometry. Transmission and reflectance samples can be accommodated and surface gloss included or excluded. New features available include forced cooling, direct reading in terms of X, Y, and Z adjusted values, dual area viewing for large and small sample areas, improved type commutator system, and optical location means for small areas.

CATALOGS RECEIVED

Kopp Glass, Inc., Swissvale, Pa., has published a new 20-page brochure entitled "Kopp Engineered Glass." The booklet describes the methods by which Kopp glass products are designed and made to meet strict specifications for light transmission and distribution, physical properties such as thermal shock resistance, dimensional exactness, selective color transmission, and other requirements.

The brochure includes a series of photographs illustrating more than 200 of the specialty items made by Kopp, as well as a section devoted to some of the production equipment used in the manufacture of the glass. The descriptive material touches on such subjects as the following: Optical Transmission Properties, Beam Control, and Engineering Design.

Richardson Scale Company, Van Houten Avenue, Clifton, New Jersey, is offering a new six-page bulletin describing the company's recently developed proportioning and materials handling system for automatically making up formulated mixes of bulk products.

The bulletin explains the operation of the electronic control system, discusses rates, accuracies, and goes into the possibilities of remote recording. Also explained is the actual formulating operation, the selecting, feeding, weighing, and mixing. The bulletin includes a large schematic drawing of a typical Select-O-Weigh system, showing the arrangement of bins, feeders, bulk scale, and batch mixers. Photos show a Select-O-Weigh control panel and an automatic scale set up for use with the system.

Link-Belt Company, 307 N. Michigan Avenue, Chicago 1, Illinois, has just released a new 48-page Book No. 2416 featuring more than 500 belt conveyor idlers in 34 types designed to meet practically every requirement.

Light, medium, and heavy-duty 20-degree troughing idlers, two styles of 45-degree idlers, flat belt, belt training, rubber cushion, and the new Link-Belt variable troughing idlers are included, all in a broad range of roll diameters and belt widths, together with return belt idlers and such accessories as idler stands, grease pipe extensions, and a grease seal and bearing extractor.

Detailed information is provided for selection and spacing, based on weight and lump size of material to be conveyed. Schematic drawings and dimensional data are included for each type of idler. Book 2416 introduces a new Link-Belt variable troughing idler on which the angle of inclination of the concentrator rolls is adjustable to provide smooth belt transition between troughing idlers and flat pulley, thus minimizing stresses and resulting in longer belt life.

Foote Mineral Company, 18 West Chelten Avenue, Philadelphia 44, Pa. has made available a new guide book on Lithium and its Compounds.

The guide book contains many new ideas and new applications of Lithium chemicals, as well as a complete coverage of the current commercial applications of Lithium compounds.

Libbey-Owens-Ford Glass Company, Corrulux Division, P. O. Box 20026, Houston, Texas, has announced publication of a new four-color folder showing seven color samples and 15 installation ideas for Corrulux shatterproof, translucent structural panels.

The folder features an interesting four-color photograph of a patio roofed with sunlight yellow Corrulux. It also gives technical details along with sheet sizes and an outline of typical uses for the product.

3D AT WORK FOR YOU

3-D may be new to the movies, but it's been playing an important role in Drakenfeld color research for some years.

Our technologists get a three-dimensional view by using the steroscopic microscope to analyze color problems. With this precision instrument, they study all conditions of blistering, pitting, crazing and crawling in the applied color. Fused glass color surfaces, color powders, fused color matrices, glass stones and devitrification crystals, the surface texture of unfired screen color prints — all reveal their secret defects when examined under the stereoscopic microscope.

The stereoscopic microscope is but one of many scientific tools used by Drakenfeld in solving color problems for customers. Our modern research facilities, technical skill and field experience are available to you. Learn what Drakenfeld service can do to help you reduce rejects and save time, effort and money. Your inquiry is invited.

DEPENDABLE SERVICE ON: Acid, Alkali and Sulphide Resistant Glass Colors and Enamels . . . Silver Paste . . . Crystal Ices . . . Squeegee and Printing Oils . . . Spraying and Banding Mediums . . . Glassmakers' Chemicals . . . Glass Decolorizers . . . Glass Frosting Compounds . . . Decorating Supplies.

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GAS-FIRED LEHRS . . .

(*Continued from page* 489)

due to too great a differential between the cooling rate in the critical zone and the fast cooling rate. This condition may be corrected by increasing the cooling rate at the critical range setting up an increased residual stress to offset the temporary cooling stress in the remainder of the anneal. As a general precaution it may be advisable to reduce the conveyor belt speed.

The lehr tunnel atmosphere should at all times be oxidizing. Experience has shown that the sulphur content in the heating gases should not exceed four grains per 100 cubic foot of gas. While overventilation may provide a passable product, the fuel rate may be a deterring factor.

Preheating of the ware should be rather slow until about 600°F. is reached and all volatile matter in the pigment has been removed. The heating rate can then be accelerated to the firing temperature, usually between 1050° and 1250°F., depending upon the glass composition. After the colors have been fired in, the temperature is lowered to the annealing point and the annealing cycle begins. Modern decorating lehrs usually have two control zones, one for the preheating and firing zone and the other for controlling the annealing portion of the cycle.

Firing Difficulties

Difficulties in proper firing of decorated ware are generally traceable to various factors: *Blistering of colors.* Preheating rate too rapid for the volatilization temperature of the vehicle used in the pigment. *Dull appearance of colors.* Maximum firing temperature too low. *Transparent or thin colors.* Lehr atmosphere neutral or reducing instead of oxidizing; presence of sulphur in lehr tunnel; decorated ware has been standing too long in a moist or dirty atmosphere before firing.

These are only a few factors influencing the firing of acceptable decorated ware in the lehr itself. Others may be the result of unsuitable decorating color vehicles or improper application of the colors to the glass. Natural gas with little or no sulphur is successfully used in direct-fired decorating lehrs, even for firing liquid or decal gold, platinum, and selenium ruby. It may at times be advisable to admit some fresh room air to the preheating section of the tunnel to hasten the volatilization of the pigment oils but this under normal conditions is hardly necessary on a well-designed lehr.

The application of internally-fired radiant tube elements is recommended in localities where hydrogen sulphide or other sulphur constituents may be present in the fuel gases. The glass industry is thoroughly familiar with the various applications of gas-fired horizontal radiant tubes to heating processes such as decorating where oxidizing atmospheric conditions are necessary. A typical decorating lehr design is shown in Fig. 6. It should be noted that the heat concentration is placed in the high-temperature firing zone and the remainder of the radiant tubes are arranged to follow the Btu requirements in the preheating and annealing zones. Since the radiant tubes operate at all times under negative pressure, no harmful gases can enter the lehr tunnel. Temperature uniformity within the tunnel is established by recirculating means. A rapid heat exchange between the radiant elements and the recirculating air passing over them is created to make heat transfer to the ware most effective since all sections of the glass are receiving the same heat treatment by radiation as well as convection under slight pressure. Thus the lehr temperature is almost reduced to the ware temperature at any controlled point along the time-temperature curve resulting in appreciable fuel economy. Controlled recirculation of the tunnel atmosphere throughout the various stages of the heating and cooling process has made it possible to reduce the lehr sizes as compared with the old style muffle lehrs. These smaller lehrs handle the same quantity of ware with much-reduced gas consumption. It is now common practice in the television industry to install lehrs for bake-out and reannealing operations with effective conveyor belt widths of over 12 feet and tunnel lengths of over 130 feet. Each five feet lehr section may be automatically controlled and recorded so that production requirements can be met with respect to top efficiency, shrinkage, and annealing quality of the end product. Gas-fired radiant tubes with their versatility of control lend themselves ideally to mass production methods and the future indicates interesting innovations in industrial lehr design.

The Process of Bending and Convexing Glass

Bending or convexing of flat glass is usually carried out at lehr or kiln temperatures above the "softening point" of the glass—i.e., from 1150° to 1350°F. depending upon the degree of convexity required. Ordinary bends such as instrument glass, lighting shades, and the like can be produced in lehrs similar to decorating lehrs but designed for higher operating temperatures. Automotive and aircraft glass involve larger surface treatment and these bending operations often take place in

(*Continued on page* 512)

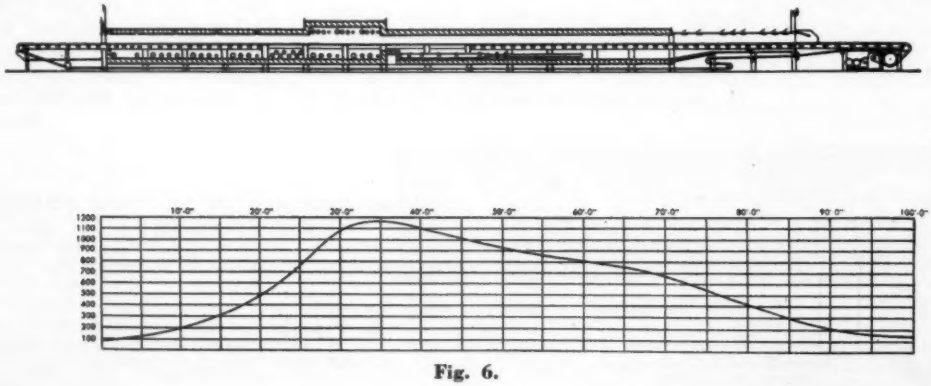

Fig. 6.

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I always call

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FIRST

SODA ASH

POTASSIUM CARBONATE
(Calcined and Hydrated)

AMMONIUM BICARBONATE

SODIUM NITRITE

Perhaps it's because I've gotten to *know* Solvay . . . to *depend* on Solvay—whether the market is tight or easy—for the chemical materials I need to help keep my business running smoothly. Or maybe it's because I know that when I have a production problem, I can call on Solvay's *exclusive glass* Technical Service for assistance. These technical specialists in glass manufacturing really know the glass business and they usually come up with some advice or suggestions that prove invaluable to me. That's why, like so many leading glass makers, whenever I need glass-making chemicals—I always call *Solvay first.*"

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A.C.S. GLASS DIVISION MEETING

Plans for the Fall Meeting of the Glass Division of the American Ceramic Society are well underway. The Meeting, to be held in Rochester, New York, on October 9 and 10, will include technical sessions, golf, and numerous plant trips. Various social activities and a symposium will be held at the Sheraton Hotel.

NEW FIBERGLAS INSULATION

An improved line of Class H fiber glass tubing and sleeving that has unusual dielectric strength and keeps its flexibility throughout the life of electrical equipment to which it is applied is now available as a result of the recent introduction of SE-100 silicone rubber coating compound by the General Electric Company's silicone products department.

Called BH "1151," his new insulation is produced in 27 sizes by the Bentley, Harris Manufacturing Company of Conshohocken, Pa., from braided fiber glass coated with the heat resistant silicone rubber. Its electrical and physical properties are unaffected by continuous operation through a temperature range of minus 90°F. to 400°F. It will also withstand 450°F. for 96 hours, 500°F. for four hours, and 600°F. for 15 minutes.

WESTINGHOUSE LAMP DIVISION APPOINTMENT

F. M. Sloan, General Manager of the Westinghouse Lamp Division, has announced the appointment of L. J. Fitzpatrick as his assistant. Mr. Fitzpatrick will have broad responsibilities in all phases of the division's operations.

A Westinghouse employee since 1942, Mr. Fitzpatrick's most recent assignment was assistant to the manager of the television-radio division, which post he held since 1946. Prior to that time, he had held several posts in the television-radio division and in the industrial electronics division.

NATIONAL PATENT COUNCIL FILES RESOLUTION

John W. Anderson, President of the National Patent Council, has announced that at a recent meeting of the Council's Board of Governors, the officers by resolution were directed to employ, in cooperation with other organizations similarly disposed, the facilities of the Council to "awaken the Nation and its Congress to the desperate need for earliest action to establish added incentive to create inventions." To create such incentive, the Council proposes early enactment of legislation to assure a "depletion allowance" and "capital gains" status as affecting all income from patents.

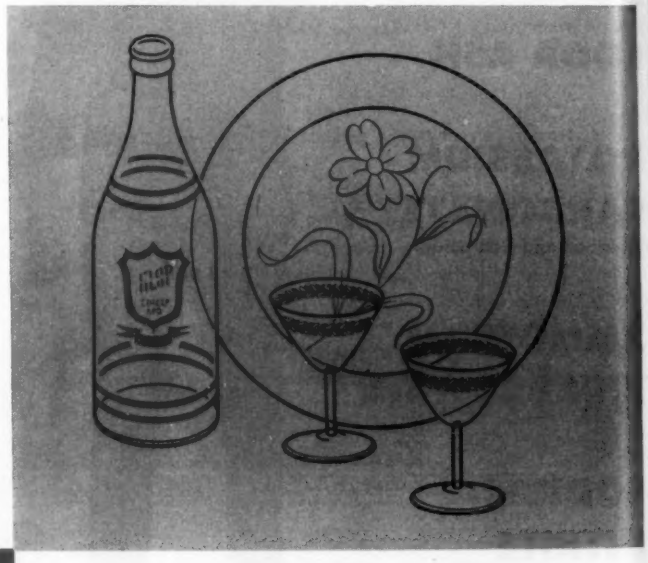
The Council's Board approved the filing in its behalf with the House Committee on Ways and Means of a statement supporting its proposal. The statement enumerates six adverse conditions that are said to depress incentive of our citizens to invent. It asserts that, unless there is a greater inducement to invent and to perfect inventions and produce them, we seem destined soon to face the tragedy of losing our technological race with ruthless foreign enemies.

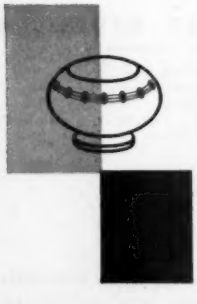
Mr. Anderson stated that "new patent applications received by the Patent Office have declined from 69,294 in 1950 to 60,386 in 1952."

DuPont Glass Colors

FOR UNIFORMITY AND EASE OF APPLICATION

THERE'S a complete line of Du Pont glass colors for your decorating needs. Each of these durable colors is produced against a permanent standard . . . assures maximum coverage over a wide firing range. You can be sure of uniformity and sparkling appeal with all Du Pont colors . . . and, as always, Du Pont technical men will be glad to give you prompt assistance. E. I. du Pont de Nemours & Co. (Inc.), Electrochemicals Dept., Wilmington 98, Del.





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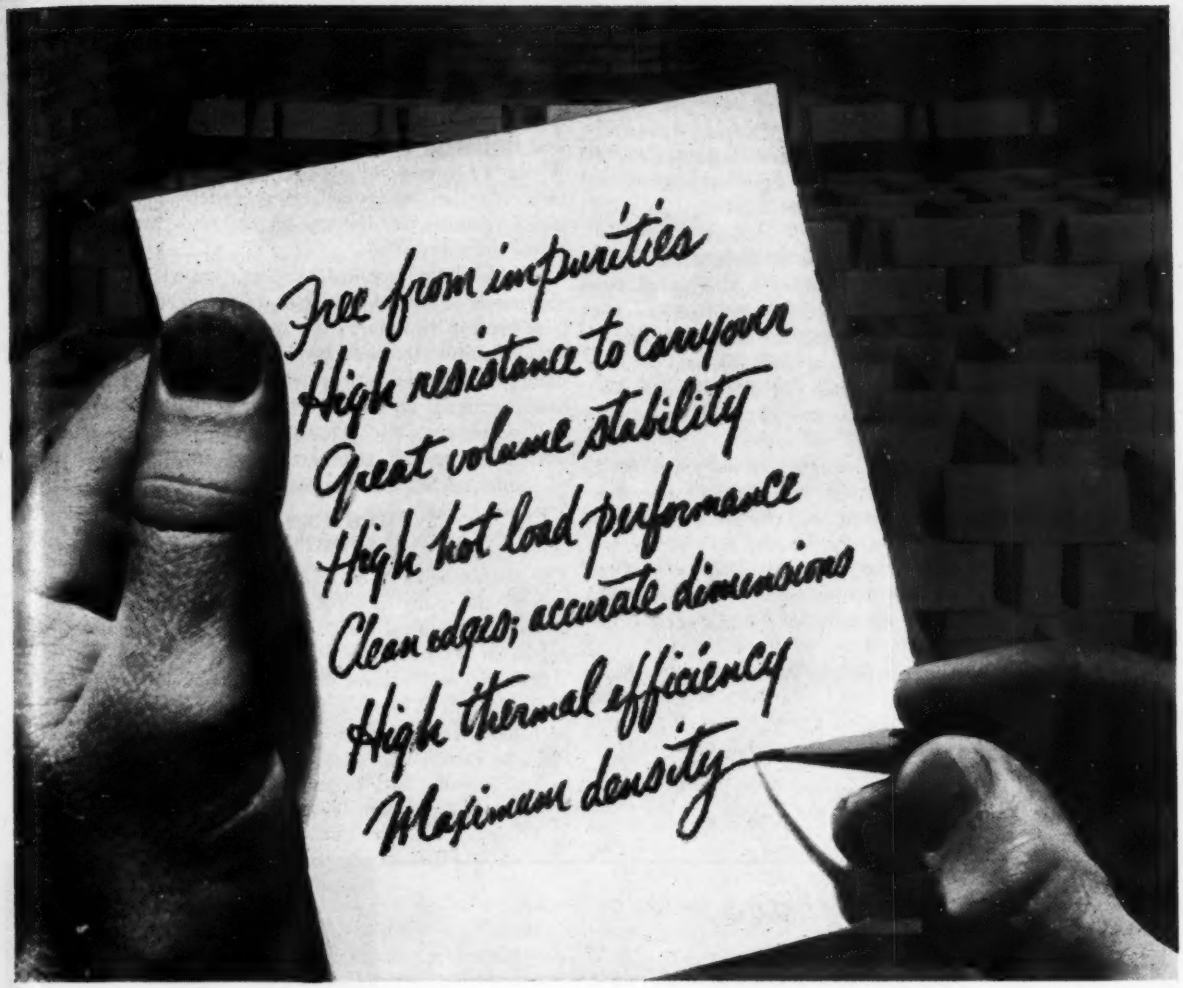
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

DU PONT GLASS COLORS



Why glass furnace checkers last longer

WITH PERMANENTE PERICLASE CHECKER BRICK

Detailed studies of continuous glass container furnaces over the past 9 years show that:

1. A properly set installation of Permanente Periclase Checker Brick can give top performance for as long as four years and

2. During this extended time, no repairs to the Permanente Periclase Checkers will be required.

Such performance is possible because Permanente Periclase Checker Bricks are made from high purity crystalline magnesia periclase grains—densely bonded under pressures up to 1,000 tons.

This results in homogeneity, with minimum permeability, absence of connected voids and maximum MgO per unit volume.

Continuous thin-section examinations prove that Permanente Periclase Checker Bricks are *your* best bet for higher production.

SEND FOR FULL INFORMATION on all the many advantages of Permanente Periclase Checker Bricks. If an appraisal of your glass furnace would be helpful, Kaiser Chemicals will be glad to work with you. Installation service at no extra cost. Standard bricks available, both burned and chemically bonded. Call or write principal sales offices: *Chemical Division*, Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California. First National Tower, Akron 8, Ohio.

Kaiser Chemicals

Pioneers in Modern Basic Refractories

Basic Refractory Brick and Ramming Materials • Dolomite Magnesia • Magnesite • Alumina • Periclase

BALL MUNCIE REVITALIZATION . . .
(*Continued from page* 484)

better ways of getting the job done."

Proof of Ball Brothers revitalization, their executives believe, lies in the figures they gave on increased activity of the Muncie operation during the first two quarters of the year; but the company's new management is quick to point out that the revitalization has been carried into sales as well as into manufacturing.

Mr. Fisher, who became Director of Commercial Container Sales last December, had added a number of top-flight men to his sales and sales service organization. He has assembled a group of alert, capable field representatives. These representatives have at their disposal for the benefit of their customers the full facilities of up-to-the-minute marketing information as well as greatly expanded customer services.

Mr. Fisher has brought an entirely new sales approach respecting the Muncie operation. "While Ball operates nationwide in the glass container and closure fields," Mr. Fisher said, "efforts insofar as the Muncie activity is concerned are concentrated upon, but not limited to, serving those companies which buy 80 per cent of the 40 million gross of glass containers annually in the mid-section of America."

It is this heartland that is feeling the stir of a new Ball Muncie operation.

INDUSTRIAL FURNACE REPORT

The industrial furnace business showed an upward trend in June after an earlier lag, bringing volume for the first half of 1953 to 93 per cent of volume for the same period of 1952, according to the Industrial Furnace Manufacturers Association's report to the industry.

Export business, while ordinarily only about 2 per cent of total volume, was more than twice as high in the first half of 1953 as in the corresponding period in 1952. While the number of orders is running behind 1952 for most types of equipment, large orders, particularly for fuel-fired units, are holding up well and cancellations are below those for 1952.

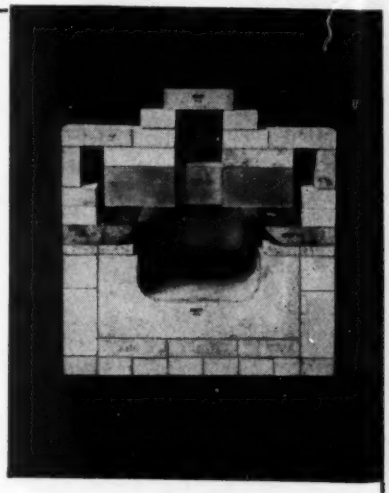
The results of a recent analysis completed by the Association show that no less than 17 major classes of industrial heating equipment are produced by 201 companies who constitute the industry. Fifty-one of the major companies in the industry produce both electric and fuel-fired furnaces, and about 60 per cent of the companies are located in Ohio, Pennsylvania, Michigan, and Illinois, although 23 states are listed among the locations of industrial heating manufacturers.

AMERICAN POTASH APPOINTMENT

The appointment of A. J. Dirksen as eastern representative of the sales development department of American Potash & Chemical Corporation has been announced by Alfred M. Esberg, Vice President.

Mr. Dirksen received his Ph.D. in chemistry from the University of Wisconsin and for the past nine years has been associated with the market development division of Phillips Petroleum Company. Following a few months in Los Angeles, Mr. Dirksen will make his headquarters at the company's New York City office.

Cleaner Glass, Low Maintenance with **CRYSTALITE Forehearths**



REMMEY CRYSTALITE (mullite-bonded mullite) is produced in all shapes necessary to make up the forehearth assembly. Burner blocks, cover blocks, channels, spouts, tubes, plungers and orifice rings are built to meet specified requirements. These CRYSTALITE parts mean better, more efficient production by offering:

★ Accuracy in formation to eliminate time-wasting adjustments.
★ High refractoriness and erosion resistance for longer life, fewer replacement shutdowns and cleaner glass.
★ Rigid control through each production phase for uniform quality and dimension accuracy.

Get Premium Performance Without Premium Price . . . by using REMMEY CRYSTALITE parts for your forehearth.

Dependable Refractories

REMMEY

RICHARD C. REMMEY SON CO.
Philadelphia 37 • Pennsylvania

BONDING FIBROUS GLASS . . .

(*Continued from page* 492)

plasticizing oils and is non-staining on vinyls meets the requirement of the third facing material.

Two methods are used to tape seams in the insulation where the facings do not overlap: bonding a strip of aluminum foil or vinyl film to the facing with an adhesive (EC-1128) or using Pressure Sensitive Tape No. 430. The tape is foil backed and need only be pressed in place over the seam to provide the same kind of protection obtained with a piece of aluminum foil and an adhesive.

Proper Application of Adhesives

The nature of the job and the adhesive used combine to determine whether a brush, trowel, or spray gun is used. Successful application depends not only on choosing of the right equipment but also on its proper utilization to assure a neat, permanent job without wasting adhesive. In all applications the surface to which the fibrous glass is to be bonded must be clean—free of dust, oil, grease, or other contaminating substances.

When using a brush, the adhesive should be applied to the structural surface in polka dot fashion. Excessively heavy gobs should be avoided since the adhesive will tend to drip from an overhead surface if too much is applied. Heavy bodied adhesives such as EC-321, EC-244 or EC-232 are applied with a trowel to bond fibrous glass insulating materials of high density (3 to 6 pounds per cubic foot). The adhesive is applied in heavy daubs to either surface being joined with a large putty knife or pointing trowel and then spread with a notched trowel or scraper. This forms small ridges of adhesive and the fibrous glass material is imbedded in these ridges with hand pressure. Many adhesives used for bonding fibrous glass pads are sprayable. If application is made by spray, the adhesive is usually applied to the fibrous glass only.

A brief description of the various adhesives discussed in this paper follows: *EC-1128.* Applied by brush, spotted to metal surface about every 4 inches, allows 5 minutes open time. Will not drip from overhead surfaces when applied in a heavy brush coat. High heat and moisture resistance. Can also be used for bonding vapor barrier tape to facings.

EC-321. Heavy bodied adhesive, non-flammable during application. Can be daubed on with a brush, applied by spray, or trowelled. Has high bond strength even when wet. Good heat and moisture resistance. Also suitable for bonding kraft facings and vinyl facings that do not contain plasticizers that would soften the adhesive.

EC-232. Spray applied for automotive roof pads. Skins over but remains wet underneath, highly tacky, allows long open time and has low immediate bond strength, permitting removal and rebonding if insulating pad is positioned improperly.

EC-244. Fast drying, high wet strength adhesive for high density fibrous glass insulation. Applied by spray or trowel.

EC-890. For bonding fibrous glass insulation where an adhesive is needed that will be fire retardant when dry, such as on shipboard. Also for bonding aluminum foil and vinyl facings to fibrous glass.

EC-226. Fast drying, brush or spray applied, high tack adhesive. Used for bonding fibrous glass pads to automobile hoods where the entire surface of the metal is coated and the pad bonded immediately.

EC-1025. For bonding aluminum foil and laminated kraft paper facings to fibrous glass insulation. Non-flammable when wet. Can be applied by roll coater. Will hold facing in place at temperatures to 250°F.

EC-1150. Bonds aluminum foil or highly plasticized vinyl facings to fibrous glass insulation. Non-flammable when wet. Can be applied by roll coater. Will withstand 300°F. without allowing facing to separate from insulation.

BOARD AND OFFICER ELECTIONS AT GLASS FIBERS

At a recent meeting of the Board of Directors of Glass Fibers, Inc., J. Fred Hedding and Thomas A. Collins were elected to serve on the Board.

Mr. Collins, Executive Vice President and General Manager of the glass firm, joined the organization in August 1952 and was appointed General Manager in January 1953. Before joining Glass Fibers, Mr. Collins had been in the glass industry for twenty-six years, all that time with Owens-Illinois Glass Company, most recently as General Manager of that company's Kaylo Division.

Mr. Hedding, engaged in the estate management business in Pittsburgh, is also a director of Diamond Alkali Company, Broderick and Bascome Rope Company, and Firth Sterling, Inc.

At the last annual meeting of Glass Fibers, Inc., shareholders voted to increase the number of directors to nine. With the election of Mr. Collins and Mr. Hedding, two vacancies still remain on the Board.

Also announced was the election of H. E. Schall to Controller and Assistant Treasurer and I. J. Newell to Assistant Controller and Cost Supervisor of Glass Fibers.

Mr. Schall has been with the firm for three years, most recently as Controller at the company's Defiance, Ohio, plant. Before joining Glass Fibers, he had been with the Defiance Machine Works, Inc., for twelve years and with the cost accounting department of Toledo Scale Company for thirteen years.

Mr. Newell has been with the accounting department of Glass Fibers for three years. Previously he had been a cost accountant with the Plaskon Division of Libbey-Owens-Ford Glass Company, and before that with Owens-Illinois Glass Company and Kroger Grocery and Baking Company.

THATCHER OPENS DETROIT OFFICE

The Thatcher Glass Manufacturing Company, Inc., has announced the opening of their new Detroit Office in the Lafayette Building. The new office will serve customers of both the Container Division and the McKee Glass Division.

Robert H. Scully, formerly of the New York City office, will be the Detroit representative for the McKee Glass Division, while Bruce Sutton will continue to represent Thatcher's Container Division.

CORNING RESEARCH CHEMISTS HONORED

Two research chemists of the Corning Glass Works will be awarded John Price Wetherill Medals by The Franklin Institute of the State of Pennsylvania for their discovery of a revolutionary photosensitive glass process.

Dr. Henry B. Allen, Executive Vice President and Secretary of the Institute, has announced that the Institute will formally award Dr. S. Donald Stookey and Dr. Robert H. Dalton the medals on the occasion of its annual Medal Day ceremonies in Franklin Hall on October 21.

The Corning men are being honored "In consideration of their work in leading to and developing a practical and commercially acceptable method for producing photographs in glass and opalescent designs in glass by photosensitive process," according to the citation accompanying the awards.

Dr. Stookey received his A.B. degree from Coe College in 1936 and subsequently received an Edward Hart research fellowship and an M.S. degree at Lafayette College. While studying for his Ph.D. degree in physical chemistry which he received from M.I.T. in 1940, he accepted a teaching fellowship there. Since that same year, Dr. Stookey has been employed by Corning Glass Works. Much of his work has been on photosensitive and opal glasses in which field he has published several papers and holds many patents. In 1950, he received the American Ceramic Society's S. B. Meyer Award given for "the most creditable publications in the field of glass technology for 1949."

Dr. Dalton was graduated from California Institute of Technology in 1925 when he received his B.S. degree. In the three successive years following, he received his M.S. and Ph.D. degrees. From 1925 to 1928 he was a teaching Fellow at CIT and from 1929 to 1930, a Ramsay Fellow at Oxford University. A research chemist at Corning Glass Works since 1930, Dr. Dalton has worked in various fields involving the development and application of glass. He has been granted two patents in conjunction with the photosensitive glass process.

HANDBOOK OF ACCIDENT PREVENTION

The National Safety Council has recently published a "Handbook of Accident Prevention."

This 93-page book has been written for the man who must divide his time between safety work and other company responsibilities. The book discusses such subjects as machine guarding, fire prevention and control, and industrial health in a way to permit the man who does not have engineering help to solve his own problems. Price, $1.50.

WICKWIRE SPENCER EXPANSION

Production of high carbon spring wire by The Colorado Fuel and Iron Corporation will be raised by about 12,000 tons annually through the addition of new machinery now being installed in the Buffalo, New York, plant of the corporation's Wickwire Spencer Steel Division, according to A. F. Franz, President.

Two modern continuous wire-drawing machines are currently being added to the Wire Mill Department of the Buffalo plant, and started operations during August.

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The conclusion was clear to Stangl: To cut costs, use slabs and spacers fortified with ALCOA Alumina . . . and that is exactly what they are doing!

If you have high-temperature problems, why not take a cue from Stangl? Investigate the money-saving features of porcelains, refractories and other high-heat ceramics fortified with ALCOA Alumina. It's a sure way to reduce down-time . . . maintain higher operating temperatures over longer periods . . . increase load-bearing strength.

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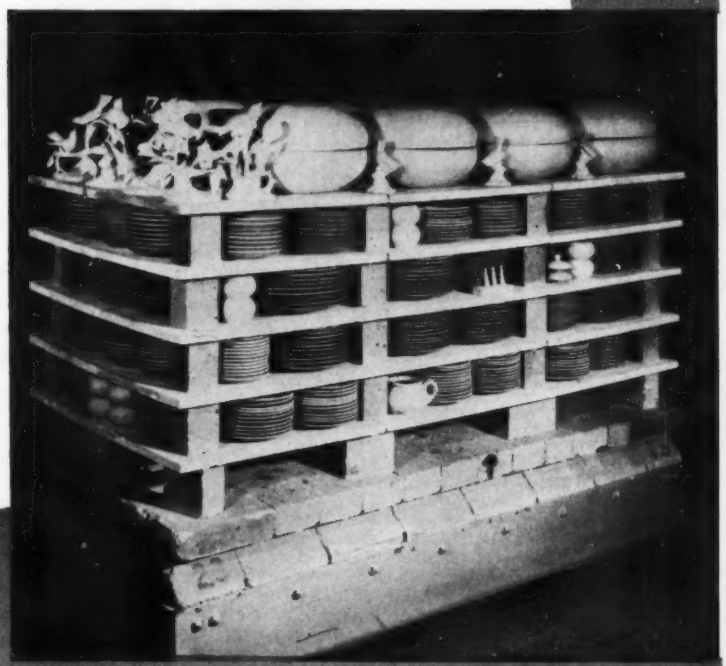
Write to: ALUMINUM COMPANY OF AMERICA, CHEMICALS DIVISION 713-J Alcoa Building, Pittsburgh 19, Pa.



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GAS-FIRED LEHRS . . .

(*Continued from page* 504)

continuous roller hearth kilns. These can be radiant tube-fired in the preheating and bending zones with the final annealing accomplished by means of a series of gas-fired recirculating air heaters, direct or indirect fired as the case may be.

The bending kilns for windshields are usually from 220 to 280 feet in length, effective width from 6 to 8 feet and the production varies from 90 to 120 "lights" per hour. Two sheets of window glass are placed on ring molds and bent together, later to be laminated. The sheets rest only upon the very narrow rim of the ring mold and one can readily conceive the importance of uniformity of heat across the kiln section as well as the need for sectional automatic temperature control. As a rule, 40% of the radiant heat is applied for preheating the incoming molds and glass sheets and the remaining 60% is apportioned as top heat mainly for softening and convexing. Flexibility is a "must" for such intricate and large scale operations inasmuch as the finished windshield will pass a rigid optical inspection before installation in cars and other conveyances.

The tempering or case hardening of back and side windows usually follows the same preheating and bending pattern of high temperature heating. Instead of being annealed, a reverse procedure is followed and the glass is immediately quenched between controllable air nozzles perpendicular to the two surfaces. This process results in concentrated and highly balanced compressive stresses when the glass has cooled to room temperature.

The Economics of Lehr Operation

Like other industrial equipment, the most economical glass lehr should represent a combination of engineering design elements and fuel economy so that: the greatest output per invested dollar is secured, the quality of the end product is uniformly acceptable, operation labor and maintenance are minimum.

Experience has shown that these conditions can be approached and met by close collaboration between glassmaker, fuel engineer, and furnace manufacturer, if all functional process requirements are intelligently interpreted and incorporated in the design to achieve the most economical heating operation.

Further improvements in fuel applications to glass lehrs are becoming necessary to compensate for other production costs, their relation to sales, existing tariffs, and the over-all efficiency of a glass plant. Yet whatever developments may bring, one cannot segregate the furnace installation from the fuel used for its operation because of the principal object involved—the liberation of the potential Btu's in the fuel and its efficient transfer to the ware to be heated.

Summary

The cost of lehr operations in the glass industry, within all practical reasons, points definitely in favor of gas fuel within the temperature ranges required and is best illustrated by over 1000 gas-fired lehr installations made in this country.

Whether the lehr is direct or radiant tube-fired, gas of uniform combustion characteristics is essential for the accomplishment of the desired physical reactions under

heat. The versatility of gas-fired installations for specific processing work and the intrinsic value of gaseous fuel are fully realized by the glass industry. This industry's high production standards can only be met with a fuel of equally high characteristics and dependable supply. It should be remembered in passing that glass generally can only be subjected to "one try" in the lehr and if fracture occurs, the ware is of no potential value.

PENNSYLVANIA CERAMICS MEETINGS

The Eighth Annual Meeting of the Pennsylvania Ceramics Association held at the Mineral Industries Building at Pennsylvania State College consisted of a three-day meeting, which included a Board of Directors meeting, two one-half day technical sessions, a general business meeting, and recreation and entertainment for members and guests.

Subjects of the technical session papers were of a wide variety, including "Industry Spokesman—The Pennsylvania Manufacturers Association," "Plastic vs. China Dinnerware," "The Motion Picture as a Public Relations Medium," "High Temperature Zirconium Phosphates," "On the Mechanism of Sintering of Oxides," and "Abrasives—Tool of Industry."

G. P. SCOTT BECOMES PARTNER IN ROBERT G. EVANS COMPANY

G. P. Scott, who for the past five years has headed the Eveready Briksaw Company of Chicago, has resigned to become a full partner in the Robert G. Evans Company. The new company, which commenced operations during 1952, manufactures a full line of masonry saws, concrete saws, diamond blades, abrasive blades, and reinforced safety-blades.

Prior to his association with Eveready Briksaw Company, Mr. Scott served as Vice President and General Manager of the Standard Steel Works, in North Kansas City, Missouri.

C. P. WALKER NAMED TO NEW WESTINGHOUSE POST

C. P. Walker has been named Manager of the General Industries Section in the industrial department of Westinghouse Electric Corporation's Apparatus Division. This Section is charged with responsibility of coordinating the development and sales of Westinghouse equipment with the needs of industries such as glass, paper, textile, rubber, lumber, leather, and food.

Mr. Walker received a Bachelor of Science degree in electrical engineering in 1933, and joined Westinghouse the following year. He subsequently served in the company's southeastern district, and held sales positions in Georgia, and North and South Carolina.

AMERICAN POTASH PRODUCING FIRE EXTINGUISHING COMPOUND

A new type of fire extinguishing agent, several times as efficient as carbon tetrachloride is now in full-scale production at Eston Chemicals Division of American Potash & Chemical Department.

Commonly referred to as "CB," the compound has a much lower level of human toxicity than carbon tetrachloride. An added advantage in aviation use is a substantial weight saving per unit of effectiveness.

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FTC ISSUES CONSENT SETTLEMENT

The Czecho-Slovak Crystal Importers Association, Inc., of New York City, and its 15 importer members, have signed a consent settlement under which they are ordered not to enter into, continue, cooperate in, or carry out any conspiracy or agreement to fix prices or conditions of purchase of lighting glass products or lighting fixtures obtained from Czechoslovakia or any other source of supply, or to maintain any prices or conditions so fixed, the Federal Trade Commission has announced.

Under terms of the settlement, they are also directed to refrain from the following: (1) inducing, coercing, compelling, or attempting to induce, coerce, or compel manufacturers of Czechoslovakian lighting glass products or any other manufacturers or suppliers of lighting glass products to restrict their sales of such products only to respondents; (2) hindering, preventing, or attempting to hinder or prevent purchasers, or potential purchasers of lighting glass products who are not members of the Czecho-Slovak Crystal Importers Association, Inc., from obtaining such products from Czechoslovakia or any other source of supply; (3) confining, restricting, limiting or attempting to confine, restrict, or limit their purchases of light glass products to Czechoslovak Glass Export Company, Ltd., or any other source or sources of supply.

In signing the consent settlement, the respondents refrained from admitting or denying that they have engaged in any of the acts or practices stated in the complaint against them as being in violation of the law.

LANGE OPENS DEPARTMENT FOR SPECIAL EQUIPMENT

To meet the demand for glass machinery to be built to particular specifications, Henry G. Lange Machine Works, Inc., has opened a special department for building this type of equipment.

This department was set up to manufacture small and large special equipment to size and production requirements such as conveyors for roughing, washing, tinning, silvering, drying, and painting; washing machines both for single or two side washing; washing and cleaning machines; cleaning machines for cleaning and drying counter dividers, jalousie strips, etc.; machines that eliminate all handling after edging is finished—cleaned and dried for packing and shipping.

LEEDS & NORTHRUP ELECTS PRESIDENT

The election of I. Melville Stein as President of Leeds & Northrup Company has been announced by the Board of Directors. Mr. Stein, formerly Executive Vice President, succeeds Charles S. Redding, who, after 14 years as Leeds & Northrup President, becomes Chairman of the Board, a post which has been vacant since the death of Morris E. Leeds in 1952.

Other changes in management responsibilities also were announced. D. H. Schultz, who has been Secretary and Treasurer since 1940, succeeds Mr. Stein as Executive Vice President while retaining the duties of Treasurer. George W. Tall, Jr., Vice President, assumes the additional post of Secretary.

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O-I EXECUTIVE NAMED TO SERVE N.P.A.

Walter A. Edwards, Manager of Government-Industry Relations for Owens-Illinois Glass Company, has been sworn in in Washington as Special Assistant to the Director of Containers and Packaging Division of the Chemical Rubber and Forest Products Bureau, National Production Authority.

Acting N.P.A. Administrator, H. B. McCoy, announced that Mr. Edwards will later assume broader responsibilities in the new Commerce Business Organization which will succeed N.P.A. Mr. Edwards is on loan from Owens-Illinois to the government under a rotation system by which the services of experienced industry personnel are provided for the new business and defense mobilization program.

Joining Owens-Illinois in 1950, Mr. Edwards formerly served 13 years as sales representative for the Pullman-Standard Car Manufacturing Company.

L-O-F FIBER GLASS APPOINTMENT

David C. Brown has been named an industrial engineer in the Fiber Glass Division factory of Libbey-Owens-Ford Glass Company, it has been announced by D. L. McClure, Factory Manager.

Until recently Mr. Brown had served as manager of time studies and methods with the Keasbey & Mattison Company, and previously has had experience in the manufacture of fiber glass. He holds the degree of bachelor of science in industrial engineering.

• Effective September 1, Metropolitan Mirror and Glass Company, Inc., will be located at Fulton Lane and East Seventh Street, Mount Vernon, New York. Construction on the new plant and offices has been under way since early Spring.

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